Review of 1916 Plant and Apparatus Developments—*An Analysis of the Economical Life of Distribution Transformers together with other articles on station and operating practice and the regular departments*

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Electrical World

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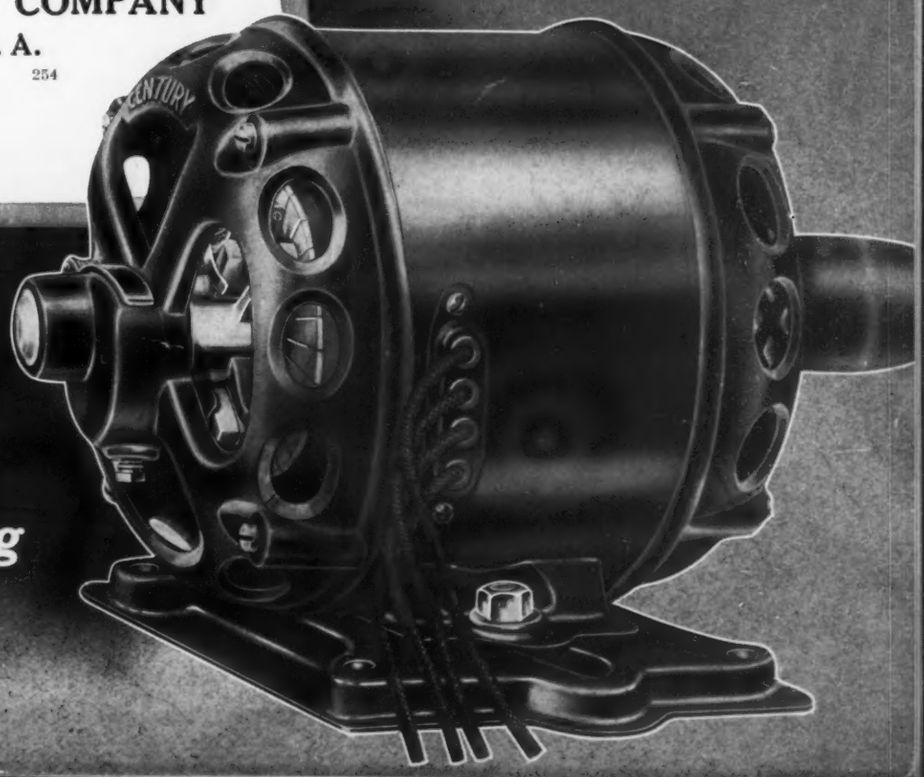

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Electrical World

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Costs and Its Problems

NO question is more momentous for the industry during the coming year than the one of costs. Costs of raw material, of manufacturing, of labor, of supplies—these will influence all operations. How long the European war will continue, how extensive will be the ante-peace and the post-peace demand from Europe for raw and manufactured products, what economic and financial conditions will prevail in this country, how far liquidation in labor and materials will extend, what the new alignments in world trade relations will be—these are broad problems whose answers will affect every manufacturer, jobber, central station, dealer and contractor. In this number we present a symposium of views from representatives of the different branches of the industry. With large issues in the background, these experienced observers of facts and tendencies do not hesitate to express their own convictions as a guide to others. The role of prophet is hazardous, but the truth is that every responsible executive of a business organization must act in planning for the future; and it is to aid in the constructive formation of necessary policies that these contributors are giving their ideas.

Educational Value of Local Meetings

THE tendency toward localizing the activities of several of our national associations, including the National Electric Light Association and the American Institute of Electrical Engineers, seems a most profitable movement. Recent meetings of the American Institute at Philadelphia and Boston and the meeting this week at Pittsburgh are typical gatherings of this sort. The greatest value of the interchange of ideas in papers comes through discussion. The more the department men in central stations and the engineers in a local community can take part in such discussions the greater is their own interest in the work. There is a second value in local activity which should not be overlooked. Not only do men associated together locally get a more direct benefit from the discussion of their every-day problems, but the community itself, under an enthusiastic leadership in such a local association, comes to realize better the civic relations of the electrical group in the community to the community at large. In several cities, in Cleveland to mention only one, the coming together of all the electrical men in an electrical league has given a unity and a sense of direction to all the electrical men in the city. Not only does the league with its permanent headquarters provide a suitable meeting place for different groups of electrical men, but general meetings on special topics of civic interest broaden the contact of the electrical men with the civic problems of the town, and the public, in its turn, looks to the local organization for advice on municipal engineering problems that touch the electrical industry. There should be more local leagues.

The Course of Copper

PARTICULAR interest is felt in the spectacular decline in the nominal market quotations for copper which followed the first talk of peace. The abrupt shifting in price to a slightly lower level suggests possibilities of great importance to the electrical industry. It is estimated in some quarters that the proportion of copper production which has gone abroad under war conditions is three-quarters of the total output. Bearing in mind the conservative calculation that in normal times one-half of the total is shipped abroad and that one-half of the balance, or one-quarter of the total, enters into the electrical industry, it will be seen that there is room for an adjustment of large proportions. However, there are several considerations against too hasty an assumption that radical curtailment in production will follow, with corresponding shrinkage in price: First, countries which have been buying heavily for war purposes will be in the market for supplies for peaceful purposes (although their enormous purchases in advance of actual needs will leave a surplus which in fact may be so large that part of it will be resold); second, nations shut off from us will need supplies, although they probably have bought and stored great quantities in anticipation of restoration of normal conditions; and, third, a reduced price level will stimulate construction at home which has been deferred by the scarcity and high cost of the red metal.

The Economics of Transformer Practice

MANY central station men will do well to consider and act upon the analysis of economic life of transformers in relation to their use as given by T. B. Morgan in this issue. It is the result of a careful analytical study of the results of continuing the use of transformers of old design on a distribution system. The history of transformer design has been one of steady improvement in design, in construction, and particularly in the quality of the iron used, the aging of iron so as to cause increase in the hysteretic losses being a familiar fact. The improvement in iron has in

later years helped out the situation amazingly, yet even at the present time there is none too much information regarding the actual extent to which this has gone. In the beginning practically all alternating-current plants in this country were operated either at 125 or 133 cycles. With the beginning of power transmission, and modern motor-bearing alternating circuits generally, a lower frequency was imperative and the first stage of hopeless obsolescence overwhelmed existing transformers when the standard frequency dropped to 60 cycles. In a measure this frequency was determined by the somewhat futile hope that the old transformers might still prove serviceable. Fortunately they burned out rapidly enough to prevent their continued use in any large quantity, but the lingering remnants of the old class (Mr. Morgan's class X) provide a horrible example of inefficiency.

As hysteretic losses increase as the 1.4 power of the magnetization, the iron losses in these transformers when operated at the lower frequency, rose to something formidable, made all the worse by the aging of the iron customarily in use twenty years ago. The next classes of transformers brought into service were those made for the right frequency but for the early standard voltage of 2080, long since replaced by 2200 volts for actual service. Here again the transformers necessarily displayed heavy iron losses, made all the worse by the lack of suitable iron. A little later the iron began to improve, the transformers were designed for the proper voltage and frequency, and the situation began to clear. As time has gone on a steady improvement in iron has brought about a great change for the better. Some of the losses found in Mr. Morgan's tests are truly prodigious and when applied to the small house transformers of the earlier days, operating under light load, show losses of energy so serious as actually to convert the customer into a losing proposition.

One interesting point brought out in these tests, however, was the comparatively small differences in results due to the use of generators of somewhat varying wave form. So far as this particular matter is concerned, within the comparatively small range of forms now found, it need hardly be given serious consideration. Another matter which appears conspicuously in this study is the better adjustment of transformer units to the distribution system. Here perhaps is the greatest gain which can be made in an alternating-current service of long standing. Even the best transformers misapplied lead to low efficiency, and the steady tendency is to replace the small units as far as possible by larger ones, feeding longer secondaries, yielding through the diversity factor a better and steadier load ratio. Rearrangements of the transformers and of the secondary circuits go hand in hand, and the general principle is that bigger and better transformers with a larger proportion of secondary copper are certain to give the best ultimate economy. The data presented show very plainly the need for overhauling the transformer equipment of a great many systems on which antiquated apparatus and methods of distribution still linger. The temptation is sometimes strong to let what is apparently well enough alone, but the truth is that in such matters nothing is well enough unless it is proved to be so. Usually, a comparatively small sum spent in intelligent testing will lead to very important economies, to say nothing of that improved service which is so important an asset of an electrical service company.

Insulating Properties of Transformer Oil

OIL has become a valuable insulating material to the electrical engineer. Being a very mobile liquid, it readily permeates crevices, to the exclusion of moisture. It has a high dielectric strength, and is chemically stable. When used in circuit breakers, it rapidly fills the gap left between the separating electrodes, in such a manner as to suppress the following arc. It is well known, however, that the insulating oils are very avid of moisture, and that they absorb moisture from the air into any free oil surface. The dielectric strength of oil containing moisture in suspension is often much less than that of pure oil. For this reason, oil insulated transformers, breakers, and other devices are kept closed from the air. The oil is also preferably filtered at regular intervals, in order to remove adventitious traces of moisture. In some laboratories relying upon oil-insulated devices, it is customary to test samples of the oil for dielectric strength at regular intervals, and to keep a record of the results.

Dust in oil is also known to exert deleterious effects on the dielectric strength. Filtering the oil removes or tends to remove both dust and moisture; so that it is often difficult to say how much of a known defect is attributable to one or the other impurity. In either case, the cause of the reduction in dielectric strength is believed to be twofold. First, the individual particles of dust or moisture, floating scattered through the oil, tend to align themselves under the stresses of an impressed electric field, thereby tending to make a conducting bridge through the mass of the oil. This is the principle of the self-building discharge path. Secondly, each separate particle either of dust or moisture in the electric field serves to condense and convey the electric lines of force toward its center. All such convergent pencils of force necessarily involve and are accompanied by increased local dielectric stress; so that the oil near to a particle tends to be ruptured much sooner than in oil regions remote from such particles. This is the principle of weakness by non-homogeneity.

A research by Messrs. Hirobe, Ogawa and Kubo on oil tests, has recently been published by the Electro-Technical Laboratory of Japan, and was abstracted in our Digest of Dec. 30. The authors point out that in cleaning the spherical electrodes of the test gap, after the passage of rupturing discharges in oil, fibers of the cleaning cloth are apt to adhere to the metallic surfaces, and in later tests to produce a bridge discharging path through the oil, so that the average dielectric strength of the oil, after cleaning, may be less than before cleaning, or the last state of the oil may be worse than the first. The moral of the story is, therefore, to use only

as electrode cleansers textile materials that do not readily impart dust or fibers to the rubbed surfaces.

The same report gives comparisons of rupturing voltages for different gap lengths in certain oils for spheres, disks and needle point electrodes. The disks had a diameter of 1.27 cm. and the gap lengths were carried up to 5 mm. with spheres and disks, and 13 mm. with needles. The curves obtained differ strikingly. It must be remembered, however, that electrical rupture between opposed sphere or disk electrodes is ordinarily a very sudden phenomenon, completed perhaps in one microsecond; whereas breakdown between needlepoints is usually a result of corona, and is a progressive phenomenon, that may occupy a much greater length of time. Consequently, the curves of volts against gap length must be expected to be different under these two different conditions.

Combining Central Station and Isolated Service

IN this issue a practical study of an extremely interesting problem is presented, namely, the relative economy of central station and isolated plant service as affected by the seasons. The scene of the experiment was a great Chicago department store and an adjacent eighteen-story office building, where power could be obtained on favorable terms from the Commonwealth Edison Company in co-operation with the building plant in its varied service. The existing conditions are not uncommon, an isolated plant using throughout the winter months large amounts of low-pressure steam for heating purposes, and all the year round carrying a lighting and motor load.

In this case there was a large group of hydraulic elevators for which the pressure was furnished by steam pumps, partly compound and partly simple. Now a steam pump even at the best is not a very efficient machine, and when the call for steam for heating falls off the net loss chargeable to inefficiency becomes a very grave one only to be endured during the months of the year when the demand for steam is very large. Even when a great quantity of steam is required for heating it is sometimes an open question whether inefficient engines are not more of a burden than a help. In this instance a careful investigation of the conditions showed that during a considerable part of the year purchased electric service for driving elevator pumps was distinctly advantageous. The smaller generating sets of the system were soon supplanted by central station service, and during the months when artificial heat is not required the load of the elevators is transferred from the steam pumps to electric pumps. When, however, enough steam is required for heating to justify the operation of the steam pumps utilizing the exhaust, the pump service is shifted over to its original form. The result has been very gratifying, for the large amount of purchased power is for a season when the central station loads are not at their highest, and the period of efficiency for the local steam plant is during the mid-winter load, so that the steam plant works at its best efficiency and throws no burden on the annual peak of the central station.

Similar conditions are not uncommon in the numerous cases where building plants have been installed not for high efficiency but with reference to the use of exhaust steam. A plant so organized must obviously be inefficient, considered merely as a power producer, and particularly so during the months of light load. Its first cost, however, is relatively small, so that under favorable circumstances the value of the exhaust steam together with the lessened overhead on the plant may make up the losses. We have a well-defined suspicion, however, that considering the rates at which electrical energy can now be purchased from the large central stations, instances of this kind are considerably more scarce than is popularly supposed, and the Chicago experience looks very much as if many an isolated plant might well consider the advantages of shutting down, at least for the period when steam heating is not required, and thus escaping the grave lack of efficiency during the periods when the load is light and the plant operates at its very worst. In many cases, too, it is extremely difficult to install a high efficiency steam plant in a building even if one were anxious to do so. Hence, all the more is it desirable to inquire carefully into what can be done with a central station service in spite of the need for steam during the winter months. The subject is one which deserves much further study, with the article mentioned a suggestive introduction.

The Coming Issues

IN the next issue of the ELECTRICAL WORLD dated Jan. 20, the number for the month devoted to scientific and engineering topics, a leading article by John L. Hogan, Jr., will review the developments of 1916 in radio engineering and communication by wire. Another article will present the fundamental features and some technical considerations in present-day transformer design. A feature of the fourth or commercial number of the month will be an article on customer growth and rate reductions, detailing the experience of two Middle-West central station companies in revising their rates for electric service along a prearranged schedule as the number of customers increases from time to time. The first issue of February will deal largely with matters of public policy in the management of central station properties, and the second number, bearing date of Feb. 10, will contain engineering articles on the different phases of station and operating practice. Among the leading articles will be one discussing the engineering and operating features of a Connecticut transmission system. ELECTRICAL MERCHANDISING, the new monthly magazine for the electrical business man, salesman, dealer and contractor, includes among its leading articles for January, an account of the work and aims of the "synchronizing" committee of the N. E. L. A., by which it is proposed to concentrate the advertising and selling efforts of the industry on one particular appliance each month.

Chronicle of Events of the Industry and of Important Movements in the Field

NEWS OF THE WEEK

Reports of Conventions and Meetings of Electrical Associations and Societies

FLOOD-LIGHTING WASHINGTON MONUMENT CONTEMPLATED

Announcements Expected to Be Made During the Coming Week—Success of the Proposition Indicated by the Interest Aroused

A movement is on foot in Washington to electrically light the Washington Monument in much the same way that the Statue of Liberty in New York Harbor was recently lighted. Announcements are expected to be made in regard to the proposal the middle of the coming week. It is possible that the engineering commission which will have charge of the electric illumination of Washington during Inaugural Week, beginning March 4, will be consulted and take part in the proposal, although no definite plans have been made.

It is understood, however, that sufficient interest in the proposal has been aroused in Washington to make the project a successful one if there are no legal difficulties in the way. In Washington the federal government owns the public parks, such as the Monument Grounds, near the Mall, in which the Washington Monument is situated. These grounds are under the charge of the War Department. Army engineers, particularly Col. W. W. Harts, U. S. A., engineer officer in charge of public buildings and grounds, would naturally be consulted, and the Commission of Fine Arts, which is composed of nationally-known artists, and which must pass on all subjects of public improvements in Washington, would pass on the final plans. It might be that Congress would have to be consulted, especially if there is an appropriation to be provided.

COMMISSION REGULATION OF LABOR SUGGESTED

New York Public Service Commission Intends to Present Drafts of Proposed Legislation to the State Assembly

Although there is commission regulation on matters of rates, operation and financial activities of public service companies in most of the States of the Union, no legislation has yet been enacted calling for regulation of wages, hours of work or any of the other problems connected with labor.

That the State of New York will have an opportunity to incorporate some such legislation into its laws is mentioned in the annual report of the Public Service Commission for the First District to the State Legislature made on Jan. 10. In reviewing the railway labor disturbances of last summer in New York City, in which the commission, being determined to assert all its powers to bring about an end to the strike, instituted a public inquiry into the causes of the strike, summoned railroad managers and labor leaders before it and took their testimony, but was unable to bring the contending parties to terms, the commission said:

"This experience clearly demonstrated the lack of power in the Public Service Commission adequately to serve the public in an emergency of this nature. The commission believes that it can be an effective and powerful agency for the State in settling labor disturbances upon public utilities under its jurisdiction if the Legislature will strengthen the public service commissions law so as to bring such matters within its purview. Accordingly, the commission will present to the Legislature drafts of bills for such amendments as, in its judgment, seem necessary."

HOLDING COMPANIES LIABLE FOR SPECIAL TAX

Commissioner of Internal Revenue Rules That They Are Subject to Excise Tax Like Other Corporations

According to a decision just issued by the Commissioner of Internal Revenue under the capital stock tax law, holding companies organized in the United States for profit are subject to the special excise tax and should file their returns.

The commissioner is of the opinion "that a 'holding company,' organized in the United States for the purpose of acquiring and holding capital stock of subsidiary companies, and actually engaged in holding such stock, voting thereon, receiving dividends thereon, and distributing money among its own shareholders, is engaged in business within the meaning of the act of Sept. 8, 1916, and is subject to the special excise tax imposed under Sec. 407.

"A ruling to this effect will be published in the weekly edition of *Treasury Decisions*, and will be followed by the department until the Supreme Court decides to the contrary.

"This ruling applies to all 'holding companies' organized in the United States for profit, even though the subsidiary companies operate exclusively in foreign countries.

" 'Holding companies' will be required to file returns on Form 707, the same as other corporations, and will be held strictly liable to the penalties imposed for failure to make such returns within the time prescribed by law."

$10,000,000 TO DEVELOP ORO HYDROELECTRIC PROPERTIES

Pacific Gas & Electric Company Seeks Purchase Approval from Railroad Commission, Disclosing Plans for Future

That an ultimate expenditure of from $8,000,000 to $10,000,000 will be made in development of the hydroelectric properties of the Oro Electric Corporation by the Pacific Gas & Electric Company was disclosed at the hearing by the California Railroad Commission when approval of the purchase was sought. From the streams in Tehama and Plumas Counties on Deer, Mill and Yellow Creeks, 130,000 hp. is finally to be developed, it was stated. In reply to a question by Max Thelen, president of the commission, A. F. Hockenbeamer, vice-president and treasurer of the Pacific Gas & Electric Company, who was the chief witness, said that in return for the grant of approval by the State of this proposed purchase his company would give a better and more

extended service with the aid of the Oro properties. Mr. Thelen indicated by his questions that the commission considered the Pacific company was about to acquire the Oro properties at an extremely good bargain. Mr. Hockenbeamer said the total cost of the properties to the Pacific company would be $1,596,334.35. The value of the properties in excess of this sum, Mr. Hockenbeamer testified, was at least $1,200,000. It might be considered a good bargain to one who had sufficient money to develop the properties, Mr. Hockenbeamer said, and on account of the way the properties of the seller and buyer fit in together his company would be able to operate them more economically and to the benefit of the consuming public. Two-thirds of the Oro properties are operative, he said, and their present total value is $2,981,740.14. The net income to be expected, including the savings to be made by Pacific company management, Mr. Hockenbeamer said, was $143,551.83, and that there would be left, after deducting annual charges, a balance of $17,755.83.

TRIBUTE TO HUGH M. WILSON BY McGRAW COMPANY STAFF

First Vice-President of the McGraw Publishing Company, Inc., Retiring from Business Connection, Is Guest at Dinner

Hugh M. Wilson has resigned as first vice-president of the McGraw Publishing Company, Inc., and will give his time to his personal interests. As a tribute to Mr. Wilson a dinner was given to him by the staff of the company at the Engineers' Club, New York, on the evening of Jan. 9. Those who were present expressed their best wishes for his health and welfare. The work of Mr. Wilson in this company involved executive responsibilities in all departments of the various papers —ELECTRICAL WORLD, *Engineering Record, Metallurgical and Chemical Engineering, Electric Railway Journal, Electrical Merchandising* and *The Contractor*. It was constructive and forceful throughout the time of his connection with the organization. His standards as a publisher were high and his strong personality has left a marked impression upon the papers which serve so many engineering, public utility and industrial activities of the country.

Mr. Wilson has devoted the greater part of his business career to newspaper work. Not long after he was graduated from Illinois College he became city editor of the *Daily Journal* in Jacksonville, Ill., his home city. From there he went to the *Minneapolis Evening Star*, but in 1889 he became identified with the *Mississippi Valley Lumberman*, and since then the greater part of his very active and successful business career has been given to trade and technical newspapers. In 1891 he was made associate editor of the *Northwestern Railroader*, and he soon enlarged his interest and activities to include duties in the business department. In 1891, when the *Northwestern Railroader* was consolidated with the *Railway Age*, Mr. Wilson was made secretary and treasurer of the new company and moved to Chicago. Later, in addition to these responsibilities, he was made manager and associate editor. In 1899 he was elected president of the company. In May, 1906, with the organization of the Wilson Company, of which Mr. Wilson was president, the business was enlarged by the purchase of the *Electric Railway Review*. This publication was changed from a monthly to a weekly, making, with the *Railway Age*, two weekly publications.

During his direction of the Chicago publications Mr. Wilson continuously exercised both editorial and business supervision. Although much of his time was necessarily absorbed in business policies, he rarely let anything interfere with weekly staff editorial meetings on both papers. These gatherings were fine sources of inspiration for the staff, promoting clear thinking and writing. Moreover, Mr. Wilson made time to write editorials himself which were models of clearness and strength for the younger members of the organization.

In 1908 Mr. Wilson sold the *Railway Age*, which was consolidated with the *Railroad Gazette*. At the same time the McGraw Publishing Company bought the *Electric Railway Review*, which was consolidated with the *Street Railway Journal* as the *Electric Railway Journal*. Mr. Wilson went to Europe for an extended

HUGH M. WILSON

tour and, returning in June, 1909, was elected vice-president of the Barney & Smith Car Company of Dayton, Ohio. He retired from that company in 1910 in order to become first vice-president of the McGraw Publishing Company.

In fields allied with his publishing work Mr. Wilson has always been active. He has supported the activities and organizations of the supplymen and for four years acted as secretary of the Railway Supply Manufacturers' Association. For his publication, through the *Railway Age*, of a daily paper at the International Railway Congress in Washington in 1905, the official journal of the congress, he was decorated a Chevalier of the Order of Leopold by the King of the Belgians.

ELECTRIC RATE CASE OF QUEENS BOROUGH COMPANY

Proposal for a Reduction Based on Idea That Gas and Electric Rates Shall Be Considered Together

In the rate case of the Queens Borough Gas & Electric Company, which is now before the New York Public Service Commission of the First District, the question of whether there shall be separate action upon electric rates or whether gas rates shall be considered at the same time is involved.

Dr. Milo R. Maltbie, city chamberlain, stated before the commission that, after a discussion of the electric rates among various parties, including Charles A. Brodek, representing the Progress Society of the Rockaways, a plan was agreed upon for submission to the commission. This involved the reduction of the electric rate from a maximum of 13 cents per kilowatt-hour to 12 cents, effective on Jan. 1, 1917. He added a suggestion that the commission make an investigation,

including an appraisal and accounting analysis, of all of the property and accounts of the company, both gas and electric.

President Carleton Macy of the company stated that the consent of the company to a reduction in electric rates was based upon the condition that, when rates were taken up, both gas and electric should be considered.

Dr. Maltbie suggested that, pending the preparation and submission of an analysis and appraisal, the hearing before the commission should be adjourned for, say, three months. He said that practically all of the energy of the company, outside of street lighting and that used for municipal purposes, was sold at approximately 13 cents per kilowatt-hour.

Commissioner Whitney said that the commission would hardly be justified in considering the electric and gas business together.

Mr. Macy said that he felt that it would not be exactly fair to the company to take up electric rates and ignore the gas rate. He felt that at present the gas rate is not as high as it should be; in fact, he felt that it should be materially increased. He thought that consumers would prefer to have the rates stand as they are rather than have a reduction in electric rates and an increase in gas rates.

Dr. Maltbie said that it was his understanding of the law that what Commissioner Whitney held regarding the impossibility legally and probably the inadvisability from other standpoints of using any profits from electricity to offset any deficit on gas was correct; that each one must be decided upon the facts that apply to that particular part of the company's business.

Mr. Macy decided that under these conditions he would like to withdraw the suggestion of a lower electric rate pending further consideration and a later hearing.

TARIFF REVISION TO BE CONSIDERED BY CONGRESS

Expected to Be a Factor in the Calling of an Extra Session—President Having Difficulty Selecting Tariff Commission

The march of events in Washington, according to the best obtainable reports, serves to show that the question of a possible revision of the tariff will be one of the principal considerations to come before Congress. President Wilson has yet to name the board which will constitute the tariff commission which was provided for by Congress, and he is having difficulty in doing so not only because of his anxiety to obtain the most suitable men but because many representations are being made to him which make possible tariff legislation dovetail in with recommendations that are to be made by the business men of the country at the coming convention of the Chamber of Commerce of the United States.

This convention will be held in Washington on Jan. 31, Feb. 1 and Feb. 2. It is reliably reported that the Cleveland Chamber of Commerce is urging that the commission be composed not only of tariff experts but shall also include at least one representative business man who has had experience in foreign trade, a representative of banking interests engaged in foreign trade, and one or more men who have had diplomatic experience. The Cleveland Chamber of Commerce is endeavoring to create sentiment in behalf of restricting by tariffs the importation of goods which will affect the establishment of industries created by the war. Other chambers of commerce, it is reported, believe that the salaries of $7,500 per annum each provided for in the act creating the tariff commission are inadequate to obtain the services of suitable members. Some chambers of commerce and boards of trade of the country are advocating reciprocity treaties between the United States and Latin-American countries. The Cleveland Chamber of Commerce is also urging tariff agreements with European countries and Canada such as will permit United States manufacturers to obtain equal rights in their markets with those of other countries and to protect United States interests at all times without discrimination.

These divergent views are being brought to the White House and it is believed in Washington that the President is giving consideration to them in connection with his possible selection of the personnel of the commission.

In view of the enormous deficit in the Treasury, as expected by the Secretary of the Treasury in his official statements, there is hardly any question in Washington but that the possible revision of the tariff will contribute to create an extra session of Congress.

BRITISH TUNGSTEN LAMP PATENT DECISION FILED

Broad Patents for Treatment of Metallic Tungsten and Manufacture of Lamp Filaments and for Improved Method of Drawing Tungsten Wire Not Sustained

Details of a patent suit before the Chancery Division of the High Court of Justice in England over tungsten filaments for electric lamps have just come to hand. The suit was brought by the British Thomson-Houston Company, Ltd., against Durand, Ltd. The plaintiff is the registered legal owner of two patents, the first, dated 1906, for an invention of a "process and apparatus for the treatment of metallic tungsten and the manufacture of electric lamp filaments therefrom," and the second, dated 1911, for an improved method of drawing wire by the use of graphite as a lubricant. The plaintiff alleged that the defendant had infringed both patents and asked for an injunction and for an inquiry as to damages.

Until recently the large and important industry of the manufacture of tungsten filaments for electric lamps was almost entirely carried on outside of England; in Germany by the Allegemeine Elektricitäts Gesellschaft, the Siemens & Halske Aktiengesellschaft, the Deutsche Gas-glühlicht Aktiengesellschaft, all of Berlin, in Holland by the Philips Metallic Glass Lamp Works, Ltd., of Eindhoven, and in the United States by the General Electric Company, the Westinghouse Lamp Company and the Franklin Electric Manufacturing Company and a number of independents.

The plaintiff claims to have discovered a commercial process for the working of tungsten and incidentally to have discovered that when tungsten is heated to 2000 deg. C., a heat which could not be obtained until the invention of the electric furnace, it undergoes remarkable molecular changes and becomes so ductile that it may be easily worked while hot and drawn through dies into wire. It said that before 1900 there was no commercial working of tungsten nor had it ever been in a form in which it could be worked, though it had been known since 1899 that if tungsten wire could be produced it could be very useful for the filaments of incandescent lamps, and that until 1904 tungsten as a metal filament, except in the form of a squirted filament, was unknown.

The defendant said that the plaintiff's claim was bad because it was too wide. It included all working of tungsten hot, and was therefore a claim to a bare prin-

ciple. What it claimed was mere routine, and no one could filch for his own monopoly one of the workman's tools. It had been anticipated by the French chemist Moissan, who had shown how to produce pure coherent tungsten in an electric furnace and had informed the world of its high point of fusion, its specific gravity and its malleability, and had pointed out that it was not affected by exposure to a moist atmosphere. In view of the state of existing knowledge there was no subject matter. With regard to the second patent the defendant said that "there was nothing new in it, for the use of graphite as a lubricant had been known for a hundred years." The trial lasted ten days.

Justice Astbury gave judgment for the defendant with costs. With regard to the first patent of 1906, relating to an apparatus for the treatment of metallic tungsten and for the manufacture of electric lamp filaments therefrom, the justice said an admission had been made which rendered it unnecessary to consider the question, except on a very narrow consideration, and the real question was the validity of the patent—want of novelty, want of subject matter, and insufficiency being alleged against it. The substantial invention, if there was one, made by the patentee was the production of a wire-drawn electric lamp filament of tungsten, but he had not been content to so limit the claim. The claim was a wide one for the working of pure coherent tungsten hot, and was not limited to any specific degree of working to any defined end provided the working was commercial working for commercial purposes. The description coherent tungsten included other forms in addition to that produced by the patentees' process. The patent was therefore bad for want of subject matter, and was invalid. As to the second patent of 1911 for improved methods of wire drawing, the justice said, on the objection of prior user, he had come to the conclusion that it was impossible to escape the consequences of the user of Messrs. Brown & Company, Preston, which was proved to have taken place in 1905 and 1906. This patent was also invalid.

FINANCING HOUSE-WIRING CONTRACTS DEFENDED

Massachusetts Gas and Electric Light Commission Hears Discussion of Commercial and Engineering Policies of Boston Edison Company

President Charles L. Edgar of the Edison Electric Illuminating Company of Boston, Mass., defended the engineering and commercial policies of New England's largest central station at a hearing before the Massachusetts Gas and Electric Light Commission on Jan. 5. The company had recently been criticised for letting contracts for construction work instead of carrying on such activities within its own organization, and its financing of house-wiring campaigns for electrical contractors had also been attacked. Mr. Edgar stated that from the beginning of his administration thirty years ago the policy of the Boston company has been to confine itself so far as possible to supplying electrical service. The company has never attempted to build its own generating plants or substations, install its own machinery, build its underground conduit or pull in its own cable. Doing such work by contract is by all odds the most economical way to handle it, the speaker pointed out. Mr. Edgar said that the New York Edison Company has only recently admitted that it would have been better if it had confined itself exclusively to the problems of electrical supply, and that the Commonwealth Edison Company of Chicago at times had been embarrassed to find work for its house-wiring organization within its own territory. "Our people get better work out of contractors than they would out of their own associates, in my judgment," he said.

The necessity for an engineering organization to check up the work, however, was fully recognized in Mr. Edgar's remarks to the commission. He stated that the engineering problems of a big company are more important in proportion to its size than are those of a smaller company. The latter can copy the work of the former to a greater or lesser degree, but the large company must make original studies and cannot copy anyone in securing the best solution of its problem. Mr. Edgar said that this is particularly true in the case of the extension of the L Street turbine plant now in progress at South Boston, and that the independent and original thought expended upon this installation will make it a superior one with many unique features.

Turning to the house-wiring campaign of the company, Mr. Edgar said that this was begun two or three years ago with the primary object of adding unwired houses to the company's system. Practically all the new houses erected within the company's territory are wired as a matter of course. More money is probably expended in interior wiring in Boston than in any other contract work, and the policy of the Boston company, which leaves the installation of such equipment to the electrical contractor, has been a tremendous asset. From 200 to 300 wiring contractors in Edison territory are in this way virtually added to the soliciting staff. The application of the installment system to house wiring has resulted in a vast number of new patrons who never otherwise would have become Edison customers. It is the biggest thing for the customer that has ever happened in Boston. Mr. Edgar said that the consumer pays the cost of securing this new business just as certainly as he meets the expense of running the sales department. The house-wiring customer costs the company less than the average because of the soliciting done by the contractors. About $100,000 is being used to finance the campaign, and the consumers meet the interest charges on this money just as properly as they provide for other commercial costs. Mr. Edgar implied that through the development of new business and resulting prosperity of the company more favorable rates are gained by the consumer. The best of relations exist between the company and the contractors as a result of its policy in the house-wiring campaign, and in the matter of fixture sales the policy of leaving these to ouside establishments is working out equally well. The Boston company sells appliances but does not carry fixtures.

Before the hearing closed Mr. Edgar stated that at some future time he desired the opportunity to present to the commission his views upon the capitalization of welfare equipment and the relation of the latter to efficiency of personnel. He conceded that some minor items which the company believes should be capitalized may be charged to operating expenses or funded in permanent loans, from some viewpoints, but said that he did not despair of convincing the commission that the general investment of the company in welfare structures and also in transportation equipment for its own service may properly be capitalized. The construction of the welfare group of buildings at the Massachusetts Avenue property by Stone & Webster instead of by the Edison company was brought up, and Mr. Edgar said that there was no question that the policy of having this work done outside was the better.

"We believe in letting the other fellow carry the overhead charges," said the witness. "The Stone & Webster organization, doing work of this kind in many parts of the country, was in a far better position to undertake the work than we were. They did the work

on a day basis, and although they do not bid upon such jobs, the result to us was unquestionably better than it would have been had we attempted the task ourselves." Mr. Edgar said that the work of the Edison company's engineering organization is charged entirely to construction.

NATIONAL OPPORTUNITIES OF THE ENGINEER

Importance of Research as Factor in Preparedness Program Emphasized at the Annual Banquet of the Massachusetts Technology Alumni

That engineers must learn to think nationally was the keynote of the speeches at the annual banquet of the alumni of the Massachusetts Institute of Technology at Boston on Jan. 6, when a number of distinguished speakers including Charles A. Stone, president of the American International Corporation, Dr. W. R. Whitney, director of the Research Laboratories, General Electric Company and a member of the U. S. Naval Consulting Board, and President Richard C. Maclaurin of the Institute, emphasized the importance of engineers and of research in solving the mighty problems before the country at the present time. An abstract of Dr. Whitney's address will appear in a later issue.

Mr. Stone, the retiring president of the alumni association, voiced the importance of preparedness as the great need of the hour. That preparedness requires technical training is not always appreciated, but the fact remains that technical training is the foundation for both military and industrial preparedness. Besides fighting, the technically trained man to-day is showing the way for maintaining the industries in the war-stricken countries, and even in the countries at peace he is more than ever before in demand, for it is he who must devise ways and means of providing substitutes for the many things no longer imported.

Every one of the belligerent countries has already made provision for rebuilding such works as have been destroyed by war and more than that in many cases elaborate preparations have been made for re-establishing foreign and domestic commerce and industry at the close of hostilities. More than ever before our foreign neighbors are on the alert to develop their own resources and turn to their advantage those of other countries.

Prompt action is essential on the part of our scientific and technical men in pointing out the things that America most needs in order to maintain and develop her industrial activities, and showing how help may be secured. We are practically without nitrogen in America and if our supply of nitrates from Chile was cut off we would be without nitric acid and hence without powder and high explosives. The government has awakened to the importance of this and has appointed an excellent commission to study the subject and show the way for producing nitrogen electrically. It is not enough, however, Mr. Stone stated, that the scientist should discover the means, but technical men must push the discovery to complete and practical development.

Closing, Mr. Stone said that there are countless problems in which the technically trained man can be of untold service to the government and to the country. The scientific and technical men of any country more than any other class can prepare the way and help develop those things which make a nation great, advance her prosperity and prepare for the future.

President Maclaurin declared that there is no part of the United States that does not urgently need and will not continue to need a large supply of men with a sound scientific training, and this demand will grow greatly in the near future. All over the country there must grow up in connection with almost every great industry large departments of research, and one of the problems of scientific education to-day is to prepare an adequate supply of men for such work. These departments of research will become absolutely indispensable to progress and even to existence in view of the competition with other nations which will surely follow the war.

Closing, Dr. Maclaurin pointed out that the countries at war are going through a priceless discipline of stern experience and that the United States is in danger of being ruined by a largely accidental prosperity which encourages a spirit of thriftlessness and extravagance. Technically trained men must devote their best energies to saving wastes and to enable the country to compete with those now in the thick of war through the exercise of economy and careful forethought.

PACIFIC COAST SECTION OF THE N.E.L.A. FORMED

Territory Covered Embraces California, Nevada, Arizona and New Mexico and Represents Over $200,000,000 of Invested Capital

At a meeting held Jan. 6, in the Edison Building, Los Angeles, the New Pacific Coast Section of the National Electric Light Association was organized. The meeting was called by Vice-President R. H. Ballard, of the N. E. L. A., and was attended by about thirty men prominently identified with the central station companies of the Southwest. The territory embraced in the new section includes the states of California, Nevada, Arizona and New Mexico. In this area there are thirty-eight Class A companies, representing a combined capital investment of more than $200,000,000, with an annual income in excess of $35,000,000. Mr. Ballard explained at length the necessity for a geographical segregation of the companies on the Pacific Coast, the objects and aims of the new section and the undoubted advantage it will give to all branches of the electrical industry.

The meeting was earnest and enthusiastic, and there was evidenced a determination eventually to make the youngest section of the N. E. L. A. the largest and most aggressive branch of the parent organization. There were several matters discussed at considerable length, among which were the giving of more equality to Class D members, particularly to manufacturers, the limiting of the number of committees and the necessity for quicker action in reporting on some engineering problems in which member companies may have particular interest. The officers elected were President, R. H. Ballard, Los Angeles; Vice-Presidents, H. F. Jackson, San Francisco, and Samuel Kahn, Stockton; Secretary, A. H. Halloran, San Francisco; Treasurer, A. W. Kemp, Los Angeles.

The personnel of the executive committee is Harry Bostwick and W. W. Briggs, San Francisco; William Baurhyte and E. R. Davis, Los Angeles; George S. Campbell, Reno, Nev.; W. P. Southard, Albuquerque, N. M.; F. S. Viele, Prescott, Ariz.; A. E. Wishon, Fresno, Cal., and A. B. West, Riverside, Cal. The public policy committee consists of John A. Britton, W. A. Brackenridge, H. H. Jones, S. M. Kennedy and A. S. Wishon.

The first convention of the new section will be held in April, the date and place to be determined later. After the meeting those present were entertained at a luncheon given in their honor by W. A. Brackenridge, vice-president and general manager of Southern California Edison Company.

Tendencies of Electrical Development in 1916

Progress Made in the Art—Effects of Higher Material and Labor Costs—Phenomenal Output of Apparatus and the Future Outlook

WHILE the year 1916 was very productive commercially it will not be noted in history for technical advances so far as the United States is concerned. All branches of the electrical industry have been taxed to the uttermost to meet the unprecedented demand for standard material and apparatus; and under such circumstances, technical development is checked or held in abeyance.

Conditions of manufacturing have also been very much unsettled. Electrical manufacturers have not only had to contend with the much higher cost of material but with a very high degree of instability in cost, the latter feature being worse than the first. This instability has been due to two factors; the changing market prices and the difficulties of securing material deliveries, entailing heavy additional cost in keeping adequate quantities on hand.

The inability of the steam railroads to sustain their part in the promotion of the material interests of the country has worked havoc not only with manufacturers but with central stations as well. Whether from shortage of freight cars, inadequate motive power or insufficient trackage, the outstanding fact remains that the railroads have conspicuously fallen short of meeting the requirements of industrial establishments.

In the midst of enormous peak loads central stations in various sections of the country have been handicapped on coal deliveries. Production had to be curtailed in many cities by cutting out of circuits at definite times, and in an endeavor to meet the conditions many central station companies have gone into the open market and bought coal at advances of many hundreds of thousands of dollars, all because the railroads were unable to bear the strain.

LABOR MARKET

The labor market has been an exceedingly difficult one. The demand for skilled labor has vastly exceeded the supply and some electrical manufacturers have been confronted with the necessity of putting on a large percentage of unskilled labor. This has resulted in a reduction of shop production efficiency and has greatly increased the difficulty of maintaining standards of quality.

Although machinists in the large electrical manufacturing plants are now working from fifty to fifty-five hours a week, the immediate goal of union labor officials is a forty-four-hour working week for machinists, that is, eight hours a day for five days and four hours on Saturday. A reduction of hours to forty-four for the entire industry would mean a reduction of productive capacity of approximately 20 per cent or an increase of plant investment of 25 per cent to maintain the same output. It would also mean a distribution of overhead over a very substantially smaller volume and a very heavy increase in the cost of production entirely aside from any question as to the payment of fifty-four-hour wages for forty-four and forty-eight hours labor.

It certainly would be exceedingly unwise at this time with the industry facing in all probability very serious disturbances at the conclusion of the European war to make radical economic departures in our industrial life. While the efforts of organized labor to force a shorter working day have met with considerable success in machine shop practice devoted to turning out munitions, their success in other fields has been rather meager. In 800 plants east of the Mississippi River, St. Louis included, over 98 per cent of the shops work between forty-eight and fifty-four hours a week. Of these 54 per cent work fifty-four and fifty-five hours a week and 22 per cent work over fifty-five hours a week.

Aside from a few linemen's strikes here and there, the central-station industry has been free from any serious labor disturbance during 1916.

REGULATION AND RATES

Very little legislation affecting public utilities was enacted during 1916. Measures granting the Georgia Railroad Commission additional powers and giving the city of New Orleans, La., the right to regulate public utilities were defeated. The principle that a public utility so long as it gives adequate service at reasonable rates will be protected against competition has been more firmly established than ever. During the year, several important valuation cases have been filed, notably, the Portland (Ore.) Railway, Light & Power Company, the Southern California Edison Company, Los Angeles, Cal., the Edison Electric Illuminating Company of Brooklyn, N. Y., and the Union Gas & Electric Company of Cincinnati, Ohio. In the case of the Southern California Edison Company, for the first time in the history of regulation in this country, severance damages were awarded for taking that part of the power company's property within the city of Los Angeles.

There has been a very noticeable drift during the year toward compromises in rate and valuation cases between the commissions, the utilities, and the public which not only avoid high cost in valuation work but expedite general reductions, or readjustments in rates, so far as the public is concerned. Within the year, there has also been a measurable movement within the industry toward improvement and simplification of rate schedules. The trend toward the Hopkinson form of rates for all kinds of power service is very well developed. The recognition of the reasonableness of a minimum bill or service charge is now general and even in those cases where class rates are not definitely co-ordinated with class costs, the rate maker, now prepares to prove that no class rate imposes a burden upon other classes of service.

From the point of view of the engineer, the progress of class cost analysis in the last twelve months is most evident. From the point of view of public policy, the offer of relatively lower rates to the small consumer in large cities and particularly to the residence consumer is almost frequent and may become fashionable. From the commercial point of view the most notable progress is that central-station companies throughout the country are reaching out for and obtaining by means of closely calculated but profitable rates the very large power business which in former years was abandoned almost without an effort to isolated plants. Simplification of rates for the sake of simplicity without regard to the equity; that is, straightforward meter rates, finds its chief proponents outside of the industry rather than within it.

Public ownership of public utilities shows a tendency to increase especially on the Pacific Coast. The city of Los Angeles has arranged to take over the electric dis-

tribution systems of the Southern California Edison Company and the Pacific Light & Power Corporation just merged with it. The development of the Hetch Hetchy waterpower project for San Francisco will probably add San Francisco and other bay cities to those operating electric systems. Seattle and Tacoma already possess municipal systems and Portland, Ore., is inclined to plunge into municipal ownership also, according to latest reports. California has had many municipally-owned and operated electric plants for a considerable period.

The recent reflections of the Illinois and Massachusetts commissions on holding companies and syndicate control may mean much or little depending on the attitude of the class of corporations referred to.

STEAM STATION DESIGN

Owing to the high cost of money and of material, and of the inability to get machinery ordered, very little new power station work has been completed during 1916. However, in those systems which have been completed and in others which are now in course of erection, very notable tendencies manifest themselves.

There is a strong trend toward steam pressures as high as 350 lb. in water tube boilers and to superheat as high as 250 deg. and above. The drift toward boiler units of 1200 and 1400 hp. has not been material, most engineers being satisfied with boilers of standard size. In large stations with good load factors, the tendency is to operate boilers at higher capacity and to install economizers. The newer stations of size indicate a decided leaning on the part of designers and operators toward the underfeed type of stoker.

Of the notable steam power stations completed during the year, the Essex plant of the Public Service Electric Company of New Jersey is reputed to be the most efficient steam station so far built, although the tests have not been completed and the data on the actual performance are not yet available. Part of the new steam station of the Buffalo General Electric Company at Tonawanda, N. Y., was placed in operation before the close of the year. Great results are expected of this plant which will have a load factor in excess of 60 per cent and which it is expected will be able to generate electricity from coal cheaper than it can be generated from water at Niagara Falls.

There have been, of course, notable additions to existing steam stations. Where applicable, there has been a perceptible movement toward larger sizes of steam turbines. Single turbo-generators with ratings as high as 45,000 kw. and three-cylinder, two-stage, three-generator units rated at 70,000 kw. have been ordered. The steam consumption of these huge units will be only slightly better than that of a 30,000-kw. unit and may in practice approximate 10.5 lb. per kilowatt-hour. Steam consumptions as low as 10 lb. per kilowatt-hour have been reported, but so far as we can learn have not been authenticated.

The high cost of material has had its effect on the design of turbo-generators. In turbo-generators of medium size the manufacturers have been able to reduce the cost somewhat below those previously designed, partly by reduction in diameter which reduces the weight of dead material and to a more limited extent the active material; and partly by the use of slightly less expensive steel in the rotors when a considerable reduction in peripheral speed is permissible.

In large turbo-generators the designs have become so difficult that only the best material can be employed especially in the rotating element. Every effort is made to secure for the rotor materials which are as reliable as possible, especially as regards homogeneity. An extension of the cross-compound unit scheme has permitted of building generators up to 70 and 75,000 kva. capacity, the gain being chiefly in the steam end, in that a large number of paths are provided for the flow of the low-pressure steam. This permits of a somewhat improved steam consumption.

In design, it is generally considered inadvisable materially to alter proportions because of increased cost of labor and material inasmuch as machines which would be best proportioned for the present market price of material would probably not be best proportioned when normal conditions again exist. Radical changes in design require considerable length of time and outlay of capital and by the time the changes would have gone into effect entirely different market conditions might exist. Nevertheless, efforts are continually being made to cheapen the product, keeping in mind what is believed to be a general average market condition of labor and material.

Manufacturers are so stocked up with orders that it is almost impossible to obtain any machinery for power plant work short of six months. The boiler manufacturers have been deluged with work chiefly from public utilities during the past six months and deliveries extend all the way from six months to one year. Very large sizes of steam turbines cannot be had short of eighteen months to two years. Smaller sizes of turbines may be obtained in from six months to one year. Similar conditions prevail among the manufacturers of reciprocating engines. Many of these are so stocked with work that they have seriously considered instructing their sales departments not to take any more orders.

HYDROELECTRIC DEVELOPMENTS

Owing to the high price of coal and of oil, many engineers have turned their attention to hydroelectric projects but owing to government inactivity, not much has been done in that line. The designers, however, have not been idle and the last year has shown an average increase in runner efficiency of 1 per cent over the previous year as evidenced by runner tests at Holyoke and turbine tests in the power house setting. Improvements in connection with turbine settings have probably been of lesser extent than this as the design of spiral casing and penstock settings in general has been very thoroughly analyzed heretofore.

Very notable advances have been made in connection with draft tube design which offered possibly the largest field for improvement. In connection with runner design, improvements have been made in the direction of obtaining higher speed so that it is now commercially economical to develop lower heads than have been considered practical heretofore.

From a mechanical standpoint, very notable advances have been made over designs of the preceding year. These advances have been in connection with size of units, details of design and the greater consideration given to unifying the component parts of the hydroelectric unit. For size of units, the past year has witnessed the design, construction and erection of single runner turbines of 31,000-hp. capacity under a head of 188 ft., which is the largest hydroelectric unit of any type ever installed. This installation has been made at the historic aluminum plant on the Yadkin river in North Carolina. Several other plants break previous records of capacity as follows: Three 27,000-hp. units under 180-ft. head, one 25,000-hp. unit under 450-ft. head, five 20,000-hp. units under 175-ft. head. These installations are all of the Francis runner type. In the im-

pulse field, no new units have surpassed the previous record of 23,000 hp. under 2000-ft. head.

As an indication of the tendency toward larger units, it may be mentioned that units 100,000 hp. in capacity under 320 ft. head have been worked out in considerable detail and their installation may be expected in the near future. These units have been studied on the basis of the single-runner, vertical-shaft, plate-steel, spiral-case type.

In connection with design, the extensive use of plate-steel circular-section spiral casings, the installation of governor flyballs directly on the main shaft, the rearrangement of vertical units to permit of dismantling the working parts from underneath the turbine, the tying together of hydraulic and electrical parts within a single rigid casting mounting within this casting a conical brake support so designed as to form a closed casing for generator fans so as to build up air pressure for circulation, and the general practice of mounting individual exciters directly on each unit above the Kingsbury thrust bearing, comprise the significant improvement. There has also been a tendency toward the use of water lubricated bearings both of the steady and thrust type, toward the use of a mixture of oil and water for oil pressure governor systems of large capacities, and for the use of mechanically-operated pressure regulators in place of the hydraulic type more generally used heretofore.

The effects of increased cost of labor and materials have resulted in increased cost of waterwheels and of many developments depending on these. For instance, a 400,000-kw. hydroelectric power project involving a 200-mile transmission to the San Francisco Bay market at decidedly higher voltage than the highest now in use would be now partly under way instead of being still on paper had conditions remained normal. Another small plant could have been built for about $120,000 but because of the advance in prices of material an additional $60,000 had to be secured to complete the installation.

A number of economies have been effected in small hydroelectric plants in the far West through the use of chain type impulse wheels with water economizing governing devices. There, the small companies whose demand curve has risen above installed capacity have avoided the necessity of new developments which would bring them under the scope of the proposed federal laws by this means. Such rebuilding affects three improvements. (1) Slight increase in efficiency; (2) ability to handle a greater amount of water with a given unit thus materially increasing the power output; (3) a material decrease in the amount of water wasted in governing, thus permitting the development of more kilowatt-hours for a given water shed. In some instances, the yearly kilowatt-hour output from a given water shed has been thus increased as much as 25 per cent.

TRANSMISSION LINES

No new records were made or no notable transmission lines constructed during the year 1916. Here and there, owing to favorable market conditions, aluminum has been taken down and copper substituted with profit to the transmission company. The maximum transmission voltage remains at 150,000 volts, and one large system has started to use copper cable with a steel core to limit corona. Steel-core aluminum cable for this purpose has already been in use for a few years.

There has been a great advance in the percentage of transformer installations that are made out of doors rather than within generating stations or substations. The percentage of outdoor installations has become so great that many manufacturers find it advantageous to make all of their products suitable for outdoor installation regardless of how it is actually ordered. No decrease in the reliability of transformers so installed has been observed.

Progress has been made on insulators mostly in the way of improving the factory product but some radically new types are appearing. A rather elaborate series of tests on insulators made a short time ago shows a distinct difference between the ordinary insulators strung together and called a suspension insulator on the one hand and the properly designed insulator connected in series on the other. The first arrangement appears to be just a string of resistance whereas the string of properly designed insulators takes the character of a condenser.

So far as the manufacture of insulators is concerned, it has been rather firmly established that well-made insulators of good design are practically lightning or puncture proof. The problem then of manufacture is to make the life of the insulator as long as possible. This calls for a low rate of depreciation, for the operating hazard increases rapidly with the percentage of defective material. Hence, the real problem of manufacture at the present time is not so much the question of design to meet abnormal electrical conditions, but one of keeping down depreciation to an exceedingly small value for a period of years. The material works on a comparatively low margin of safety for the internal mechanical stresses set up during operating conditions. These stresses are usually much higher than those set up by the working loads and usually determine the life of the insulator. This has necessitated considerably more care in the small details of design and assembly so as to keep down internal stresses and thereby reduce the danger of cracking.

One great advance has been in the attention given to vitrification. Where formerly ware was considered acceptable over a range of from 80 to 100 deg. C., the present acceptable range in some factories is approximately half this value. Those familiar with the manufacture of porcelain will realize what this improved standard means in the way of improved manufacturing conditions. Insulators have been so improved in manufacture and design and the cost is relatively so small that there is little need of operating a line which causes considerable trouble. Many of the older lines have been reinsulated simply as a matter of good business. There is a general realization that to obtain successful performance, the manufacture has to be carried on very carefully. Otherwise, the best designs will cause trouble through defects or poor material and no amount of testing or inspection can make up for deficiencies in manufacture. Equipment costing large sums of money has been placed in some of the factories to insure that the standards of quality will be maintained and improved with the increasing production required.

The co-operation of power companies on the Pacific Coast in financing research in a well equipped laboratory under the direction of an eminent authority in such matters is a commendable move.

TRANSFORMING APPARATUS

The year in transformer production has, as in most other lines, been principally noteworthy for large production rather than development. That is, there has been so much production, that engineers have had to devote their attention to this, to the exclusion of development work. On the other hand, the large production has given an excellent opportunity to take advantage of the large amount of development work that had

been carried on during the quiet times of the preceding eighteen months.

The large production has been principally noteworthy because it has not been the result of any great demand for transformers for new power developments, but rather for the tremendous demand for power on the part of manufacturers who could not in most cases put in additions to their own power plants in short enough time to take care of their increased demands for power. A very great increase in the demand for transformers for electrochemical processes has also been noted which, of course, is the result of great effort which America has been making to produce chemicals which were formerly produced abroad.

There has been but little that is radically new introduced in transformer design during the past year. Not much improvement was to be expected in the quality of sheet steel and what little improvement there was, was utilized. There has been, however, considerable improvement in insulation as a result of the careful study of insulation, its properties and methods of application.

The maximum primary voltage remains at 150,000 volts although transformer designers stand ready when called upon to produce good transformers for 200,000 volts as well. Probably about the most striking trend to be noted is the rather rapid increase in the size of units. There has been a marked elimination of any hesitation on the part of the customers' engineers to buy large units. Transformers of high voltage and large capacity have so established their reputation for reliability that practically no one hesitates to have the transformer units as large as the generator units from which they receive their power.

There are under construction at the present time 14,000 kva. 150,000-volt single-phase transformers which are the largest high-voltage single-phase transformers that have ever been built. There have also been built during the past year self-cooled transformers of 8000-kva. rating. Of course, combined self-cooled and water-cooled transformers were built in small numbers previous to 1916 but their use has been increased very rapidly of late. With the increased use of outdoor installations, there has come naturally the demand for increased capacities of self-cooled transformers; first, because artificial cooling is applied with somewhat greater difficulty outdoors, and, second, because there is no difficulty in disposing of the heated air coming from self-cooled units. To meet this demand, there has been developed methods of building transformer tanks and movable radiators which admit of economically building self-cooled transformers in any designed capacity. There has been but little change in performance; the efficiency, of course, increasing slightly with increase in size. A strong tendency toward comparatively high reactance in order to assist in protecting the transformer and other apparatus from the destructive effects of short-circuits on large power systems has manifested itself.

Rotating transforming apparatus has of course kept pace with developments in other lines; the most noteworthy achievement being the erection of synchronous converters with a continuous rating of 6825 kw.

ELECTRIC MOTORS

The demand for electric motors of all kinds has been phenomenal. Manufacturers have been unable to keep pace with developments, and as a result the second-hand market has been emptied of most of the motors it possessed. These were needed for taking care of vast industrial loads because of the inability of manufacturers in industrial lines to obtain prime-mover equipment in time to take care of their increased orders.

In the fractional horsepower motor field, a great deal has been accomplished during the year toward developing special motors for special purposes. The problems have been largely of an application nature and have involved the modification of standard designs to meet special conditions. A number of companies, for instance, have developed motors particularly adaptable for the operation of domestic washing machines and pumps. There has also been a very broadening influence in the use of very small series-wound universal motors for a large number of devices. Motors have been developed for operating musical disk machines and a number of little devices used in the home, the office and the shop. Many advances have been made in the processes of manufacture of these small motors which have tended to increase their uniformity and particularly their reliability in operation, which has been one factor in their increased use.

The increased price of material has not only affected the price of these motors but has also played a very important part in the design of them. The designing engineer in this country has now been forced closer to European practice and every bit of surplus material is being done away with.

The year has shown an increasingly large demand for small low-voltage generating equipment for farm and country residence lighting. Most of these units are supplied with storage batteries. Their use has been promoted to a certain extent by the use of the automobile and the lighting system therewith, for the farmers are very large users of automobiles. This is opening up a field for the use of low-voltage, direct-current motors for operating small household appliances, and, of course, the sale of such appliances themselves will be increased.

It is surprising to what extent small electric motors are being used. A very large number of toy motors are sold and also little motors used in connection with automobile horns, small portable vacuum cleaners, etc. Some manufacturers of these devices are building their own motors as are also manufacturers of vibrators, hair dryers, etc. Without doubt, the so-called fractional horsepower motor manufacturers are turning out from 200,000 to 300,000 motors a year aside from those manufacturers who build small motor-driven devices themselves and make the motors to be used in connection with them.

The outlook for 1917 is certainly very bright for fractional horsepower motors. This applies particularly to the sale of motor-driven domestic appliances. Domestic labor conditions are a very large factor in forcing the use of small motor-driven machines, as is evidenced in the case of the electrically-driven washing machine, etc. Undoubtedly, a large future exists for the motor-driven domestic dish washer and the motor-driven domestic refrigerating machine.

There has been very little constructive standardization undertaken by the motor manufacturers during the past year. The bulk of the work has been in perfecting some of the details of the standardization which had already been accomplished. The only important change of the year has been the recognition of two ratings for open-type motors having continuous time rating. The old standard of a 40 deg. temperature rise with a two-hour 25 per cent overload guarantee at 55 deg. C. is maintained, but a new rating has been added covering a motor with a 50-deg. temperature rise guarantee under continuous operation without any overload temperature guarantee. The 50-deg. rating utilizes the maximum temperature rise possible under the limit for impreg-

nated insulation recognized under the rules of the American Institute of Electrical Engineers, but does not take into account the fact that under off-rated conditions in actual operation these temperature limits can very readily be exceeded. It is for that reason that some manufacturers still feel that in cases where the load conditions are not accurately known or determinable, it is advisable to use the 40 deg. rating which offers the greater factor of safety. In addition to the standardization of motors and generators, the manufacturers through the Electric Power Club have now started the commercial standardization of transformers and industrial control.

Storage Batteries

So far as we have been able to ascertain, there have been no radical improvements in storage-battery work during the year. The gasoline automobile industry utilizes an immense quantity of storage batteries in connection with electric ignition and lighting sets. The increased use of farm lighting sets has also been of great benefit to storage-battery manufacturers. In fact, the sale of storage batteries for ignition and low-voltage lighting work far exceeds in amount the sales of storage batteries for all kinds of electric vehicle work.

Electric Vehicles

There was a very perceptible increase in the output of electric vehicles during the year, particularly of pleasure cars. The gross sales of both pleasure and commercial vehicles approximated $13,000,000, of which $9,000,000 represents the sale of pleasure cars and $4,000,000 the sale of commercial vehicles. In the case of pleasure vehicles this is a gain of considerably over 40 per cent during the year.

Illumination

Incandescent lamps of both the gas-filled and regular types have found wider application during 1916 than ever, and the output of low-voltage and battery lamps has been phenomenal. While the gas-filled lamp has shown a tendency to supplant the arc lamp for street lighting in large cities in the East, the luminous arc still continues to hold its own. West of the Rockies the year has witnessed a number of notable installations of luminous arc lamps for street lighting purposes and the tendency in big cities there seems to be toward the luminous arc lamp rather than the gas-filled incandescent lamp for public lighting. During the last few months incandescent lamps of any kind have been very difficult to obtain.

The indirect and semi-indirect lighting fixtures have increased greatly in popularity and flood-lighting of buildings, statues and natural wonders has never before been so widely applied. The manufacture of a 50-watt tungsten is of more than passing interest to central station companies particularly in the larger cities where an equivalent substitute of the old carbon incandescent lamp has been sought.

Electrochemistry and Metallurgy

Progress in all branches of electrochemistry during the year has been phenomenal. The great electrochemical industries located in Niagara Falls, N. Y., have been seriously handicapped for want of power and as already indicated, there has been a great demand for transformers for electrochemical purposes. Electric furnaces particularly for refining steel have shown an increase in the United States during 1916 of almost 50 per cent; the total now in use in this country being 136 Other features of electrochemical and electrometallurgical growth were outlined in these columns last week.

Industrial Research

There has been considerable progress made during the year in industrial research, but it has of necessity been devoted more to application work in connection with the vastly increased business of the corporations rather than in putting out notable and epoch-making inventions. Investigation shows that the functions of industrial research laboratories have been to a very considerable extent those of assisting and helping production at a time when many of the ordinary materials in use before the war have practically disappeared from the market and substitutes have had to be found and processes modified to produce a satisfactory product with the changed material and tremendously increased production.

One of the most notable occurrences of the year so far as research is concerned has been the organization of the National Research Council. All branches of science and industry are becoming fully alive to the necessity of thorough advance research work in order to put the United States to the forefront of progress. Undoubtedly the European war has had a great deal to do in focusing attention on this general subject and much to do with the feeling in industrial circles generally that they must be alert in looking to their interests in this way. A number of the universities are represented in the National Research Council and there is a very evident desire on the part of the universities so to order their work that it will be better co-ordinated with the type of work which must of necessity be carried out by the industrial corporations. One large electrical manufacturing company has built during the year a laboratory for advance research work sufficient to accommodate when fully equipped approximately 100 men. The general idea back of it is that advances must be made in working out fundamental principles and that this work must not be hampered by the necessity of solving daily commercial research problems.

Central Station Output and Outlook

The central stations of the country, particularly in the East and Middle West, have been prosperous during 1916 and the outlook for 1917 is bright. Not only is this true of output of electrical energy but also of sales of electrical apparatus and appliances on the part of those companies engaged in such business. Commercially the notable feature of the year, aside from the increased motor load, has been the development of the electric range field.

Increases in the price of coal and oil and the inability to obtain that which was contracted for have kept down earnings somewhat and those central station companies that were forced to make extensions and additions were compelled to pay advanced prices for the equipment. Copper is still very high and although the output of the large producers has been sold for 1917, there will be a sufficient quantity available for the needs of manufacturers and central stations at a somewhat lower price during the year. A considerable break in the price of copper occurred when the first peace rumors were circulated in this country, and it is certain that if peace does come during the year copper will drop considerably. This will not be true of coal, however, and the indications are very clear that advances in coal even on yearly contracts will reach 50 per cent and above. This will probably be felt worse by isolated plants than by central stations, and it is reasonable to expect that wideawake central station managers can, by taking advantage of the situation, add vast isolated plant loads to their systems.

Effect of High Costs on the Industry

Opinions as to the Influence of Unprecedented Material and Labor Prices Upon the 1917 Activities of Consulting Engineers, Central Stations, Manufacturers, Jobbers and Dealers and Contractors

By Herbert A. Wagner

President National Electric Light Association

HERBERT A. WAGNER

WITH other industries the electric central station companies have shared in the great prosperity which has blessed the business of the country during the past year. Great increases have been secured in the sale of electric energy for manufacturing purposes. Whether these increased sales will be duplicated during the year to come depends partly upon the probability of increased output by manufacturing concerns, but largely upon taking advantage of certain unusual phases of existing conditions. It would seem to be assured, at least, that the business already secured would be retained, for a large proportion of the industrial users of power have their factory output sold for at least a year ahead.

The difficulty of obtaining machinery and machine tools may be a serious obstacle to further expansion, but even this may work to the advantage of the central station. The situation as to deliveries is especially bad with the manufacturers of electrical generating apparatus and steam engines and turbines. The impossibility of getting deliveries of power plant equipment within a year or more after placing orders is practically prohibiting the installation of isolated or factory power plants, and forcing power users to consider central station service.

In spite of the fact that central station service is usually cheaper and more convenient than isolated plant service, a considerable proportion of large industrial power users have refused to give it fair consideration in the past and have complacently continued to make their own power without any exact knowledge of its cost. During the past year, however, many manufacturers have been obliged to add to their power facilities with the least possible delay. The central stations were ready to supply the increased demand, and in many cases with the result that the whole power question was opened up for fair debate and the isolated plant abandoned.

With the increasing costs of fuel and wages the central station, with its power rates unchanged, has a new advantage in isolated plant competition. While it is true that the advancing cost of fuel and labor affects the central station company as well as the manufacturer, increased output acts to offset to some extent the threatened increase in operating expenses per unit.

From all indications I cannot but believe that the coming year holds the brightest prospects for great increases in central station power load, with the largest earnings yet attained. The opportunity for the practical elimination of the isolated plant, with its attendant smoke, dirt, heat and inconvenience, for the benefit of the community as well as the central station, is with us as never before and I would urge all managers to awake to the fact and take full advantage of it.

By H. W. Buck

President American Institute of Electrical Engineers

H. W. BUCK

THE high cost of materials prevailing at the present time is a matter with which the consulting engineer is vitally concerned. The success of all engineering undertakings must be gaged to a great extent by financial units, and initial cost is one of the factors of controlling importance. Not only have material costs risen to figures unknown for many years, but labor is high, scarce and inefficient, and deliveries on material and products of all kinds can only be secured after almost prohibitive lengths of time.

All of this operates as a retarding influence to new enterprise, which is the field in which the consulting electrical engineer finds his greatest field of usefulness. Very little new construction is being undertaken at the present time, except that which is absolutely necessary, or in cases where abnormal construction costs may be justified by special commercial conditions.

A manufacturing or a mining enterprise may find it good business to enlarge its plant under present conditions, because the high cost of construction is offset by the high cost at which the product can at this time be sold. Profits may be so large that construction costs can be written off from one year's earnings.

A central station may extend its plant under present conditions of high cost as a public service obligation, to meet the demands of its customers, or as a matter of policy rather than accept the alternative of having the customer install a plant of his own.

The great industrial activity in this country at the present time can be identified largely with special conditions of this kind.

Separate and distinct new enterprises, which must be founded financially on normal peace conditions, cannot afford to burden their future with the interest charges resulting from present high construction costs, and very few of such undertakings seem now to be in progress or in contemplation in the near future. The great delay in obtaining machinery or equipment of any kind is also a discouraging influence.

Necessity, however, is the mother of invention, and the high cost of materials should serve as a stimulus to the engineer to devise ways and means of economizing in the use of materials or in the substitution of new materials of lower cost. New processes and methods can and will be devised for producing and utilizing ma-

terials more economically. Much work along this line has already been accomplished.

In the field of electric power transmission, the high cost of materials has brought about unprecedented conditions. This field of electric enterprise seems to have been given temporarily a knockout blow—copper has doubled in cost since the beginning of the war, aluminum is almost unobtainable at any price, and even iron wire galvanized, which has been a serviceable conductor for use at the highest voltages, has trebled in cost. Galvanized steel for transmission tower fabrication, has risen to over three times its original cost. Corresponding increases apply to all of the miscellaneous supplies entering into line construction. Underground cables have been similarly affected in combination with the rise in the cost of lead.

Such increases are prohibitive, and upset all of the economics of power transmission as previously accepted. If these conditions are to continue for any considerable length of time, power transmission engineers must resort to new transmission methods with higher voltages than have ever before been considered commercial, as one possible means of reducing the quantity of material required. Possibly the hardships from costs now prevailing may in the long run prove a benefit to this branch of electrical engineering in stimulating new developments and inventions.

The high cost of coal should work as an indirect advantage to the central power station. While it increases of course, the operating expense, it also increases, to a relatively higher degree, the cost of operation of the competitive isolated plant.

Any permanent increase in the cost of coal, and some such increase now seems probable, should give the water power companies a new lease of life, and should lead to the establishment of new plants, which under former conditions of coal cost could not figure any economy over steam-turbine operation.

Apparently the consulting engineer must make the best of the high cost conditions as he now finds them, and wait in patience until the world has cleared itself from its present chaotic condition and settled down to a reasonably definite and secure outlook toward the future.

By Albert Lincoln Salt

Vice-President Western Electric Company

ALBERT LINCOLN SALT

THERE is no precedent in the history of this country for the high prices and scarcity of supplies from which manufacturers have suffered during the past year. The demand for raw materials at increasing prices, which has always obtained in times of intense industrial activity heretofore, lacked the powerful stimulus of the present war. The enormous volume of orders from Europe, the resulting prosperity of the nation and the inability to get material from belligerent countries have, in my opinion, combined to produce the conditions of 1916. Accepting the war as the basic factor in the abnormal state of affairs with which manufacturers are contending, it follows that a change in such conditions (that is, the coming of peace) will modify the status in price as well as the supply and demand conditions. The acute stage, which appears to have been reached in 1916, was the climax of conditions which evolved very rapidly. The year 1914 was divided into three distinct periods:

First: Before the commencement of the war industrial depression was pretty general.

Second: The condition bordering on panic, the result of the actual declaration of war, which lasted about two months from Aug. 1, 1914; foreign markets ceased to exist and the local market was weak or shattered.

Third: This period began with the rapid adjustment of our industries to the altered outlook, and indications of the true nature of this adjustment began to be very apparent in the increased prices of various commodities, although some items either failed to advance or actually declined to lower levels.

Percentages of Increase Over Prices Prevailing on Aug. 1, 1914	On June 1, 1916	On Oct. 24, 1916	On Dec. 15, 1916
Acid, Sulphuric	175	63	63
Aluminum	108	145	145
Antimony	533	121	137
Batteries, Dry	68	68	68
Brass, Rod and Sheet	174	174	185
Copper	126	116	166
Fiber	113	113	113
German Silver	105	105	114
Crossarm Bolts	175	175	175
Crossarm Braces	274	274	274
Guy Clamps	160	160	160
Lead, Pig	94	81	94
Paper, Cable	70	60	71
Platinum	98	109	133
Rings, Aerial, 2 in	39	13	13
Rubber, Para	...	10	14
Silk, Spun	65	57	57
Silk, Tussah	36	35	64
Spelter	216	80	113
Steel, Bess. Billets	123	135	177
Strand, 10,000 lb	77	92	123
Thread, Linen	158	200	200
Tin, Pig	66	33	38
Tinsel	25	25	29
Vermillion	167	167	167
Vitriol, Blue	329	174	233
Wire, Iron Telegraph, 10 Ex. B. B.	50	55	76
Wire, Outside Distributing	19	36	47
Wire, Bridle	35	59	86
Wire, Inside	27	57	144
Yarn, Fine Cotton	...	20	105

It was in 1915 that the real upward movement in cost reached commodities of every character. Substantially all orders placed in the fall of that year involved higher prices and delayed deliveries.

Even in normal times the expenditures of the Western Electric Company amount to millions of dollars annually, while at present, when costs are 100 per cent greater than those of two years ago, its expenditures are double the sum of ordinary years. In a great many commodities it is the largest buyer in the world; and no other organization, I believe, has so many ramifications in its purchasing connections as this company, the scope of its requirements being so great that they reach practically every legitimate source of supply in the United States and Europe. Necessarily, we analyze at all times the conditions covering every commodity.

In view of the great number of producers and manufacturers from whom we buy and in consideration of the large investments we are obliged to make for our regular requirements, we are carefully studying the situation for 1917. In my judgment, the war, or its aftermath, will be the controlling factor, and if the

beginning of the end of the terrible conflict is in sight, as it now seems, I believe that liquidation is bound to develop; and it will certainly be better for business if it comes without a sudden and severe shock and proceeds in an orderly way to a return of more normal conditions. The prospect that the coming readjustment will be gradual is strengthened substantially by the fact that the manufacturing capacity of the country is sold ahead for a year.

By Robley S. Stearnes

President National Electrical Contractors' Association

ROBLEY S. STEARNES

IT is my firm conviction that prices of building commodities have little effect upon the amount of construction. But one branch of the building public is possibly controlled by these influences, and that is the rich estates, which do their building when all commodities are at lowest ebb, but this is not a very serious or important factor. When commodity prices rise, due to well-known economic causes, they do not affect one industry alone, but spread from one to another, and from one section of the country to the other; all manufacturing enterprises are stimulated and real estate investments advance, offering opportunities for speculation which are not overlooked.

One can look to the future with reasonable assurance and, even though an early peace in Europe is declared and Eastern munition industries are disarranged, all the other industries of the country will retain the impetus which has brought greater activities to this country than ever before. I fear the outcome if the manufacturers continue to raise the already "high enough" prices on everything, and more particularly on some articles that should remain as at present or be at lower prices.

In the smaller work of construction the buyer knows little of the intrinsic value of the commodities we sell, and his idea of a cheap price is gained merely from a comparison of the bidder's figures.

In my judgment the time is too early to contemplate or prepare for lower values. The apex of higher commodity values and wages, I fear, has not been reached, and if we follow the history of the past there is no justification for anticipating any early decline.

BRIGHT PROSPECTS IN THE SOUTH

As to the prospects for the Southland in 1917, it is not mere optimism to say that the general business outlook was never better. Prices of its agricultural and other products are higher on an average than at any other time in forty-three years, and the purchasing power of the people has been greatly increased. Confidence has been restored. The people, encouraged and enabled to proceed with their plans, are building the foundations of permanent prosperity. Agricultural and business methods are being improved, diversification practised as never before, and there is a more rapid development of our rich agricultural and other resources. There is reason to believe that good times in the South have come to stay.

By J. C. Schmidtbauer

Vice-President Julius Andrae & Sons Company

J. C. SCHMIDTBAUER

NEVER before in the history of this country has the farmer received such high prices as he now enjoys, or the wages paid for labor reached the height at which they are now found. And so long as this general era of prosperity is prevalent there will be no perceptible decrease in the electrical business. The industrial plants, central stations and electric railways will continue to be active, although building operations may be retarded to a slight extent by the fact that smaller residences will not be built on account of the advanced prices. With the railroads spending $83,000,000 for car equipment during the month of November, it would seem as though we have not as yet reached the apex of this era of prosperity which is upon us. Reports are constantly coming to us that mills and factories are in a very congested condition, and with the amount of business which has been booked there is no reason why we should expect an immediate and staggering reaction after the European war. Many central stations are specifying their copper requirements for delivery well into the middle of 1917, and from the observations which we have made we cannot foresee any decline in the prices of metals, but it is felt that on account of the shortage in the market, prices will continue to soar.

In this connection the one vexatious problem confronting the electrical supply jobber to-day and demanding serious consideration, is the reduction of overhead costs. One of the first steps to be taken toward reducing the overhead cost lies in the education of the dealer to anticipate his requirements as much as possible and to buy staple articles in standard or unit packages. Orders are usually received in piecemeal fashion and clearly show from the manner in which they are made out that materials are purchased from hand to mouth without any attention being paid to standard package or unit quantities. Naturally, the cost of unpacking and reshipping orders specifying from twenty to fifty different articles is very materially increased.

Then, there is the question of returned goods and the expense connected with handling them, which is one of the largest items entering into the jobber's overhead cost. Many electrical jobbers find that the amount of goods returned during the year represents from 3 per cent to 5 per cent of the total of their gross business. The necessity for returning goods could be obviated in fully seventy-five out of 100 cases if the dealer would only communicate with his jobber and ask for suggestions as to how to dispose of them, or if he made an earnest effort to move them.

Costly mistakes are made frequently through the failure of the manufacturers to pack and properly label cartons containing their products. The day when the manufacturer can assign a catalog number to each article placed on the market will be welcomed by the electrical jobber, for it will prevent considerable confusion and lessen expense.

It is now admitted that the electrical jobber is a permanent factor in the distribution of merchandise, and everything that helps him reduce his costs must necessarily also aid the trade he serves.

Factors that Determine Economical Life of Transformers

Considerations Involved in an Investigation to Ascertain Whether It Is Economical to Continue in Service, Hold in Reserve or Condemn and Junk Long-Used Transformers

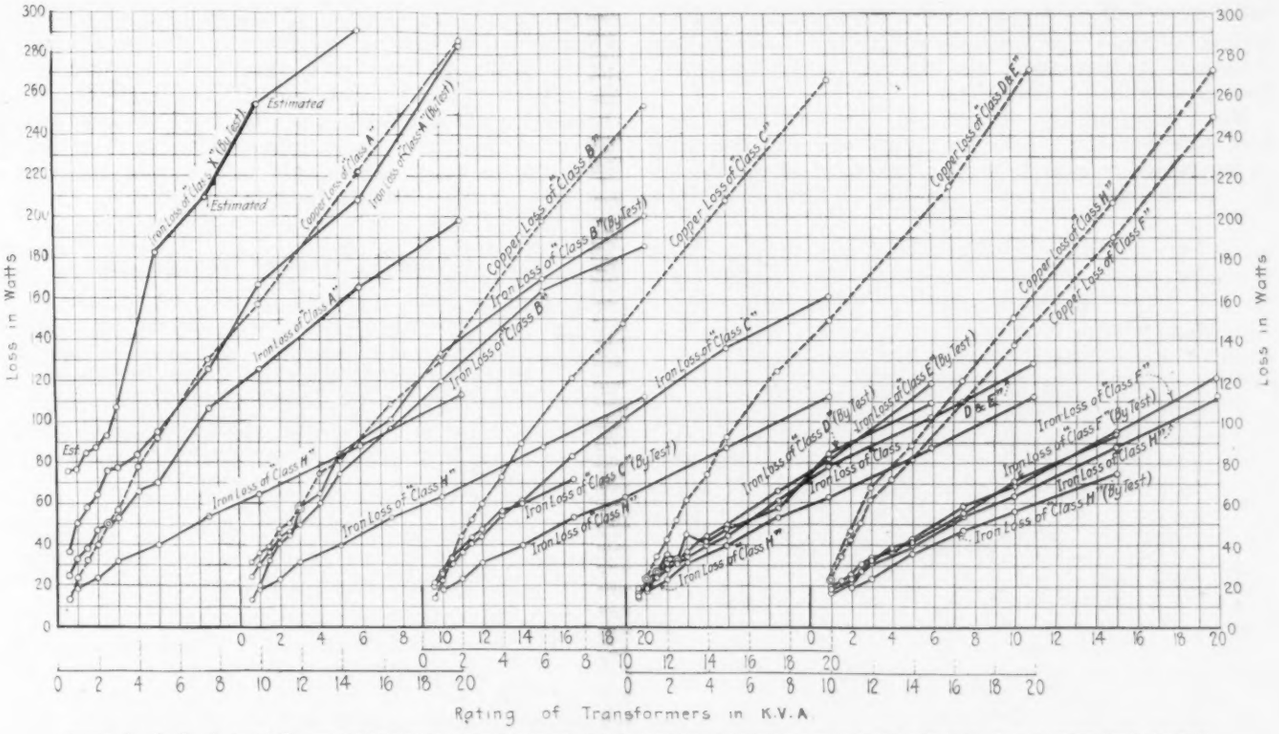
BY THEODORE B. MORGAN

UNLESS steps are taken occasionally to weed out inefficient or antiquated transformers from distribution systems certain units will be found which have become uneconomical to operate as compared with newer designs. This is especially true of "old timers," since as a rule they age more rapidly than modern types. According to manufacturers' statements and judging from results of tests to force aging, recently designed transformers do not age appreciably. It is doubtful, therefore, whether future developments in this apparatus will permit sufficient reduction in losses to justify the replacement of modern units for this reason alone. It should be emphasized, however, that only future experience can prove this contention.

To determine whether it is economical to continue in service, hold in reserve, or condemn and junk transformers which have been in service several years the writer has conducted extensive investigations, part of the results of which are presented in what follows. In arriving at conclusions it was considered advisable to take the following conditions into account: (1) Unit cost of energy at the switchboard; (2) number of hours per day normal and maximum load is liable to last; (3) relation of transformer rating to connected load; (4) iron loss; (5) copper loss; (6) kva. drawn from feeder by transformer for exciting at no load; (7) cost of new transformer to replace one in service; (8) size of wire and load carried by feeder giving service; (9) distance of transformer from station; (10) power factor of feeder load; (11) profit that can be realized by central station by change; (12) service characteristics; (13) better regulation given to secondary distribution system.

Data included under the first item were readily obtained from the company's operating accounts, while information on items 2 and 3 was secured by making tests in typical districts and by comparing the ratings of transformers in service with statistics secured from the commercial department. Tests on thirty-odd transformers rated at 0.6 to 5 kva., and which had been in service for different periods up to seventeen years, were made to secure data for items 4 and 5, these being facilitated by the replacement of the units shortly before the tests by transformers of large rating.

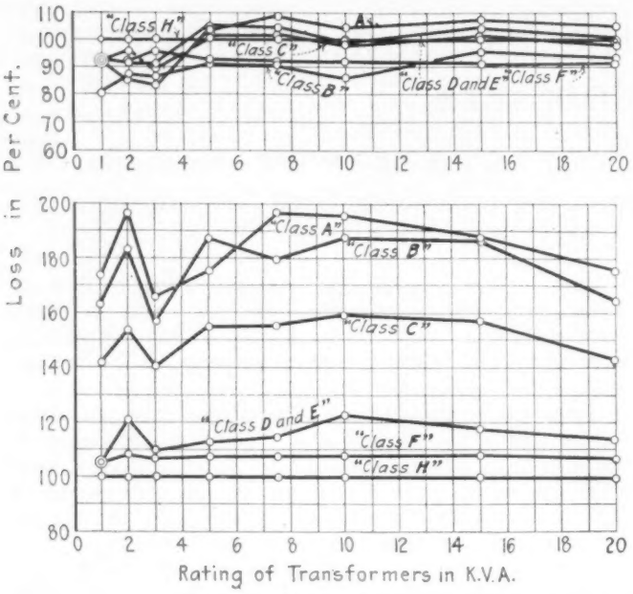
These tests as well as all subsequent ones were conducted to show the losses under operating conditions, voltage being applied to the low-tension coils of the transformer at the rating given by the manufacturer. No attempt was made to insure pure sinusoidal waves. On the other hand, it was most desirable to have the wave formation identical with that supplied to the system under operating conditions, otherwise the tests would have been valueless or would have given erroneous results when applied to distribution problems later on.

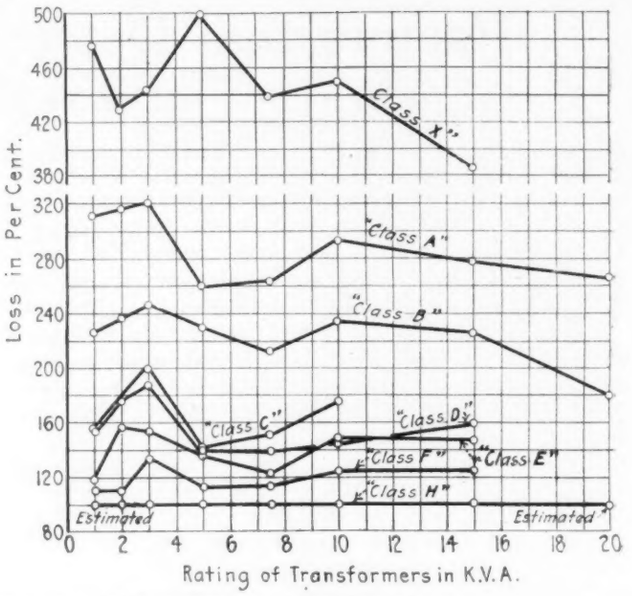

Loss in Watts
Rating of Transformers in K.V.A.
Estimated
Iron Loss of "Class A"
Copper Loss of "Class A"
Iron Loss of "Class A" (By Test)
Copper Loss of "Class B"
Iron Loss of "Class B"
Iron Loss of "Class B" (By Test)
Copper Loss of "Class C"
Iron Loss of "Class C"
Iron Loss of "Class C" (By Test)
Copper Loss of "Class D & E"
Iron Loss of "Class D" (By Test)
Iron Loss of "Class E" (By Test)
Iron Loss of "Class D & E"
Copper Loss of "Class F"
Iron Loss of "Class F"
Iron Loss of "Class F" (By Test)
Iron Loss of "Class H"
Iron Loss of "Class H" (By Test)

FIGS. 1, 2, 3, 4 AND 5—COMPARISONS OF TRANSFORMER LOSSES AT TIME OF MANUFACTURE AND AFTER OPERATION

Preliminary tests were made to determine what apparent changes might be expected under varying conditions. When generators producing different wave forms were paralleled on the system the difference in loss was apparent, but to such a small degree that it was not appreciable. Operation of generators on two other systems caused a greater variance, but at no time greater than 2 per cent.

Other tests made to determine the variation in loss when the rated voltage was impressed upon the transformers with and without additional external variable





FIGS. 6 AND 7—COMPARISONS OF THE IRON AND COPPER LOSSES OF TRANSFORMERS

All of the curves are plotted with the assumption that the losses of class H transformers are 100 per cent. The curves of Fig. 6 are based on the average losses at time of manufacture while those of Fig. 7 are based on actual test data. The upper curve of Fig. 6 represents copper losses and lower one iron losses. Fig. 7 also represents iron losses.

resistances indicated that when a lamp bank or meter-testing rheostat was used the error introduced by the change of voltage wave was not sufficient to be more than discernible by the tester.

When the iron and copper loss data had been tabulated, however, the results for transformers of the same rating varied so greatly that it was hopeless to attempt any conclusions without securing information that would permit classification of the data. Consequently, manufacturers were asked for the history of transformer design and for such data as would be used to classify the transformers into groups, each group to represent a distinct departure from the preceding group as regards iron and copper losses. Lists of these losses were also secured. From this information all of the 900 transformers tested to date and having ratings from 0.6 kva. to 600 kva. were classified as follows:

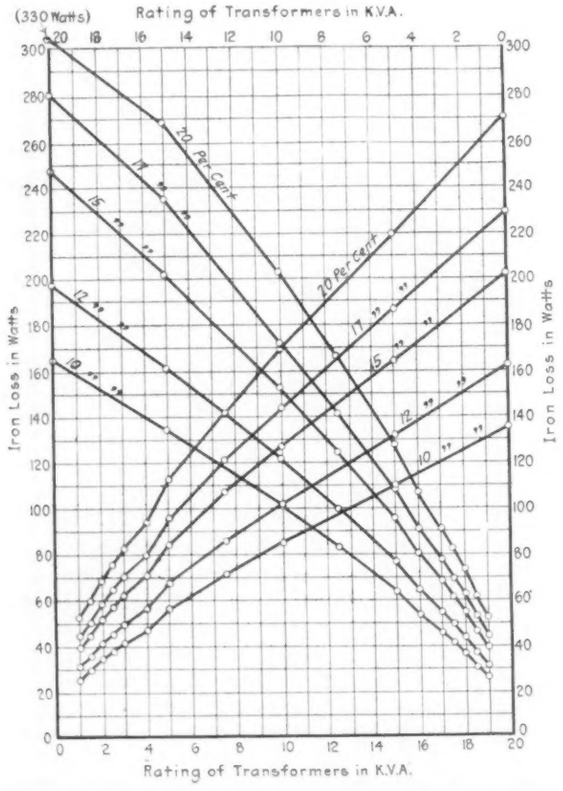


FIG. 8—RETURN ON INVESTMENT WHICH CAN BE REALIZED BY SUBSTITUTING NEW TRANSFORMER FOR ONE HAVING CERTAIN IRON LOSS

The curves sloping upward to the right are based on the values given in the right-hand column of Table II, while those sloping to the left are based on the figures in the second column of the table. An energy cost of ½ cent per kilowatt-hour is assumed.

TABLE I—CLASSIFICATION OF TRANSFORMERS*

Class X	Designed for 133-cycle, 1040/2080-volt primary, 54/108-volt secondary, about nineteen years old.
Class A	Designed for 60-cycle, 1040/2080 volt primary, 54/108 or 108/216-volt secondary, nineteen to eleven years old.
Class B	Designed for 60-cycle, 1040/2080-volt primary, 54/108 or 108/216-volt secondary, eleven to nine years old.
Class C	Designed for 60-cycle, 1100/2200-volt primary, 110/220-volt secondary, nine to six years old.
Class D	Designed for 60-cycle, 1100/2200-volt primary, 110/220-volt secondary, six to five years old.
Class E	Designed for 60-cycle, 2200-volt primary, 110/220-volt secondary, five to four years old.
Class F	Designed for 60-cycle, 2200-volt primary, 110/220-volt secondary, four to one years old.
Class H	Designed for 60-cycle, 220-volt primary, 110/220-volt secondary, less than one year old.

*All transformers operating on 60-cycle, 2200-volt, with 110 and 220-volt, two and three-wire secondaries.

With this classification as a guide, cards were selected from the transformer files for four transformers of each size in each class. By routing a regular testing crew according to these cards it was possible to make a large number of tests with the least amount of travel, 118 tests being made in one district. The exciting currents were determined at the same time for item 6. Since some of the transformers of each class were miles apart or could not be disconnected for testing, and as certain sizes of some classes were rare or were not in use at all, it was impracticable to carry out the initial intention of testing four transformers of each size. However, enough tests were made so that data were secured for about 23 per cent of the total number of units installed, the smallest percentage for any class being about 18 per cent for Class E. Where data could not be secured for certain sizes of any class, where the data were insufficient for making satisfactory averages, or where the tests were not as accurately conducted as desired the losses were estimated.

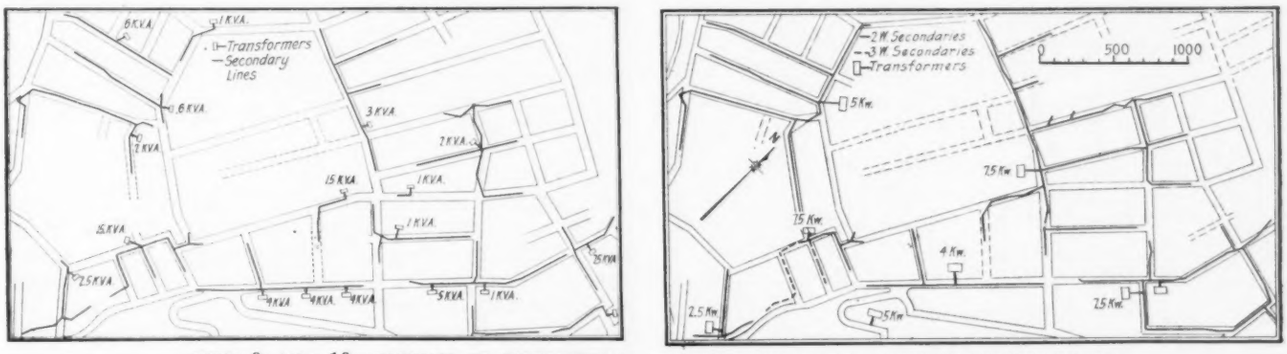
While test data were secured under operating con-

ditions for transformers rated as high as 600 kva., only that for sizes (up to 20 kva.) which are most common on all systems have been plotted, since it is by the proper selection of these units that the largest saving can be made. The curves are based on the average losses as found by over 500 tests made during a period of four years, and are shown in Figs. 1, 2, 3, 4 and 5, with curves plotted from the data furnished by manufacturers on losses at the time of manufacture. The manufacturers also gave data on what the losses should be at the time of test, but the values were much below those actually measured, due probably to differences which exist between theoretical and actual conditions. For instance, wave form in commercial may not and is usually not sinusoidal, the transformer may be overloaded in kilovolt-amperes but not in kilowatts, and the oil used for heat radiating purposes may be lacking or not in the proper operating condition, thus permitting the iron cores to age.

While Class X and some of Class A transformers were operated for a time without oil as a heat-radiating medium, this condition was corrected in 1902-1903. The oil in many of the older types had reduced from one-third to two-thirds of its original bulk, thereby becoming thick and sluggish. Several cases were found where the oil and insulating compound had combined into a thick, sticky mass covering part of the laminations and coils. These conditions were taken into consideration after making the tests on the transformers, it being decided that the iron loss had not been affected except where excessive load in comparison to the radiating capacity had been carried. The averages of test results can therefore be used only as a guide for transformers of the class tested, as the losses of each individual transformer are liable to change. For estimating purposes, however, the curves will be found fairly accurate. It may be pointed out that for the period of transformer development represented, the iron losses of similar size units have been gradually reduced and the ratio of copper loss to iron loss gradually increased from 1:1 to about 2:1, thus permitting a higher all-day efficiency when the load factor is low. Figs. 6 and 7 compare the iron and copper losses of modern transformers with those of older types in percentages.

From the manufacturers' list prices and discounts for different size units figures (Table II) were obtained on which to base the cost of replacing transformers. The cost to set transformers on lines includes freight, cartage, etc., and is an average for removing and setting a number of transformers when arrangements have been made to carry on the work systematically. The junk values are based on prices that have been paid in the past for good transformers with high iron loss. These figures are necessarily arbitrary, as it is impossible to arrive at true costs for a great number of points where freight, cartage and labor conditions differ from those assumed. From this data and the assumption that energy at the switchboard costs 1 cent per kilowatt-hour curves slanting upward to the right in Fig. 8 were plotted. On account of the different methods used in computing depreciation and the fact that many companies set aside a reserve fund rather than figure depreciation on small items, depreciation is not considered, although it may readily be introduced and results worked up for individual cases with the figures and curves given. A comparison of the curves of Fig. 8 with those of Figs. 1, 2, 3, 4 and 5 shows that the substitution of a modern type transformer for a Class X transformer will pay 20 per cent on the investment, while the replacement of Classes A, B, C, etc., will permit gradually smaller returns. The curves in Fig. 8 which slope upward to the left show smaller returns from the substitution of modern transformers, since they are based only on the cost of the new transformers and not on the replacement cost.

Additional advantages are often secured by changing transformers, such as increasing the feeder rating, improving power factor and regulation, since two or more transformers can often be replaced by one and the conductor combined to serve as one circuit.



FIGS. 9 AND 10—PORTION OF DISTRIBUTION SYSTEM BEFORE AND AFTER REARRANGEMENT

When the iron loss of transformers is relatively high and the consumer's consumption small the cost of energizing the units will sometimes exceed the actual income received. Such a case was found where a 5-kva. transformer of the X class was serving a single customer whose bill never exceeded the minimum charge of 50 cents per month except one month of the year. The income was $9 a year while the cost of service, including $7 interest on fixed charges and $17.50 for energy consumed by the transformer, made a total yearly cost of $24.50 without charges for consumer's energy, bookkeeping, meter reading, billing and the like. With an iron loss of 180 watts the power factor was 20 per cent at no load. Since 900 kva. was supplied to the transformer the greater part of each day the line loss was way out of proportion to the energy sold and the rating of a 9-mile section feeder was considerably reduced.

While all central stations endeavor to keep their dis-

TABLE II—ULTIMATE COST OF NEW TRANSFORMERS ASSUMED FOR ESTIMATING PURPOSES

Size of Transformers in Kva.	Cost at Factory	Cost Set on Lines	Junk Value of Old Transformers	Ultimate Cost of New Transformers on Lines
1	23.00	26.00	3.00	23.00
1.5	27.00	30.00	4.00	26.00
2	32.00	35.00	5.00	30.00
2.5	36.00	39.00	6.00	33.00
3	40.00	43.00	7.00	36.00
4	47.00	50.00	9.00	41.00
5	56.00	59.00	10.00	49.00
7.5	73.00	76.00	14.00	62.00
10	89.00	92.00	18.00	74.00
15	118.00	121.00	25.00	96.00
20	145.00	148.00	30.00	118.00

tribution systems from becoming loaded with networks of wire or over-rated transformers, points can invariably be found where there is too much wire and too little transformer capacity or too much capacity for the size of the installation. Such conditions cause a loss to the operating company, and unless careful supervision is maintained in making extensions or installing transformers, thousands of dollars may be uneconomically strung in the air instead of being used to better advantage elsewhere.

In working on secondary distribution systems, it has been found that iron losses are often rated far below the actual figures. For instance, an excitation current of 0.5 per cent to 10 per cent of the unaccounted for current, as sometimes claimed, is entirely too low. Tests show that a system furnishing twenty-four-hour service must be in perfect condition to show a loss as low as 20 per cent, while for sparsely populated residential districts the loss is seldom as low as 40 per cent. Analyzation of the unaccounted for current in a number of systems indicates that distribution transformers take up anywhere from 38 to 60 per cent, estimators usually overlooking the fact that iron loss is continuous for the twenty-four hours in the day and for 365 days in the year. Another item which is usually overlooked is that old transformers have the greater losses and should be considered separate from the more modern types, which have very low losses by comparison.

TABLE III—COST OF SETTING TRANSFORMERS AND VALUE OF THOSE REMOVED FROM CONNECTICUT SYSTEM

Kva.	Transformers Set	Cost of Transformers Set (Table II)	Transformers Removed	Value of Transformers Removed if Purchased at this Time (Table II)	Transformers Removed from Lines in Excess of those Set of Same Size	Value of Excess Transformers if Purchased New
.6	1	$23.00	6	$138.00	5	$115.00
1	2	46.00	12	276.00	10	230.00
1.5	4	108.00	9	243.00	5	135.00
2	.....	.....	5	160.00	5	160.00
2.5	3	108.00	6	216.00	3	108.00
3	3	120.00	7	280.00	4	160.00
4	.....	.....	4	188.00	4	188.00
5	4	224.00	7	392.00	3	168.00
7.5	8	584.00	10	730.00	2	146.00
10	1	89.00	1	89.00	.....	.....
15	2	236.00	5	590.00	3	348.00
20	.....	.....	3	435.00	3	435.00
25	.....	.....	3	576.00	3	576.00
30	1	219.00	.....	.....	.....	.....
40	1	270.00	.....	.....	.....	.....
Total....	30	$2027.00	78	$4313.00	50	$2769.00

As an example of a case where the foregoing considerations were taken into account in rearranging a distribution system the accompanying maps and data of Table III are presented. The map in Fig. 9 shows distribution conditions in a section of a Connecticut town before changes were made and where the system had grown with the demand for service.

In rearranging the system seventy-eight of 141 transformers were removed and thirty hung on the lines, making ninety-three transformers with a total rating of 1487 kva. instead of 141 with a total rating of 1709 kva. About the only transformers purchased for the change were a 30-kva. unit and a 40-kva. unit, since a sufficient number of various sizes were secured by rearranging to fit in places where transformers were needed. In general the secondaries were not run more than nine sections from their corresponding transformer. When it was possible to form loops, however, twenty to twenty-five section secondaries could be employed on fairly heavily loaded circuits.

In addition to other wire removed and run as noted elsewhere about 6000 ft. of No. 6 new weatherproof wire, which cost 30 cents a pound, was removed and substituted by copper-clad wire equivalent to No. 10 copper that cost 15 cents a pound two years before. This substitution was permitted by making one long run with a 1-kva. transformer at the end, the copper-clad wire being obtained from a suburban line where the increased load had demanded a change to a larger size of conductor.

For the benefit of companies contemplating changes similar to those outlined, attention is called to a few of the many difficulties encountered. For instance, after the primary and secondary system have been mapped and comprehensive tests made on the feeders, transformers and secondary system, the value of the results may be entirely lost because infrequent loads have not been taken into consideration. If some evasive load of this nature crops up it may be necessary to change conductors and transformers, making the expense about double the initial or estimated expense. Such occurrences can often be avoided, however, by conferences with the line superintendents and foremen, who are usually acquainted with the characters of the loads. Better teamwork will usually be obtained, too, if their confidence is secured, since they do not generally take kindly to reconstruction of work which they have spent time and money to perfect. Another point to recognize is that the good will or enmity of the community will be secured depending on whether the rehabilitation is attended with improved or unsatisfactory results. Under no consideration should anyone undertake extensive readjustments unless he has a knowledge of local conditions, good engineering training, practical experience, and testing and mapping facilities.

TABLE IV—SAVING DUE TO REMODELING OF CONNECTICUT DISTRIBUTION SYSTEM

Transformers removed from lines	78
Kva. capacity	421.1
Value if purchased new	$4,313.00
Transformers set on lines	30
Kva. capacity	199.1
Value if purchased new	$2,027.00
Saving in kilowatt-hour per year in reduced iron loss	36,667
Valued at 1 cent per kilowatt-hour	$366.67
*Added rating of 11,000-volt feeder in kva	20.50
Pounds of base wire removed, 2313 (junk), valued at	$578.25
Pounds of weather-proof wire run, 2150, valued at	$602.00

*Due to increasing power factor of exciting current.

Methods of Preserving Insulation on Wires Crossing Railroad Tracks

Insulation on wires crossing steam railroad tracks are subjected to severe treatment when an engine happens to stop under the line and gives off heat and gas. While asbestos insulated wire seems best suited for such installations it has been suggested that a coating of water-glass on the outside of the insulation would very materially lengthen its life, if something besides asbestos should be necessary. This coating is best applied just before or after stringing the wires. The ordinary water-glass solution would be satisfactory and two coats are recommended.

Where experimentation with different insulating compounds is not feasible, and the number of conductors and climatic conditions permit, it would eventually be least expensive to elevate all conductors beyond the range of influence of the locomotives. The practice of some companies is to place conductors underground at railroad crossings within city limits. This practice has advantage in that it eliminates friction and disputes with railroads and civic bodies, practically removes life hazard and the possibilities of legal disputes, while at the same time the cost of maintenance and the likelihood of service interruptions are reduced.

Joint Use of Central Station Service and an Isolated Plant

Alternate Seasonal Use of Central Station Energy and Isolated Plant Steam Has Proven Most Economical Arrangement for a Chicago Department Store

WHEN negotiating for the sale of central station energy to replace an isolated plant, attempts are often made to displace all steam-driven units by electric motors. This is not always advisable or even expeditious, as will be shown by the considerations which were brought out when arrangements were being made to make use of central station energy from the system of the Commonwealth Edison Company in Hillman's department store in Chicago. Here, the broader policy of the power company, which has as its aim the development for the customer of the most economical plant for his conditions, resulted in the recommendation of a combination use of existing equipment and central station energy. The power company's engineers made a thorough study of this particular situation and equipped a power plant in a manner which involved a minimum first cost and has produced an annual saving in operating expenses of a large sum.

The change-over hinged principally about the water pumping for nine hydraulic elevators, although the change in the plant included the discarding of four small steam-driven generator units, a steam-driven ice machine and a number of other small engine units. Live steam is required in rather large quantities for the candy shop, bakery, lunch counters, steam tables, coffee urns and various kitchen apparatus the year round, and hence the boiler plant could not be dispensed with. A few of the auxiliaries, the house pumps, drinking-water pump, sprinkler pumps, etc., have been continued on steam operation during all seasons to supply what exhaust steam can be absorbed in the feedwater heater and for hot-water requirements in the building. In addition, steam for heating and hot water is furnished to an eighteen-story building adjacent, owned by the same interests. Live steam is also furnished this building the year round for steam pumps for four hydraulic elevators, house pump, two ejectors and a 30-cu. ft. air compressor. With the eighteen-story building and the six-story department store building to heat in winter, large quantities of low-pressure steam are required. This is admirably furnished by the exhaust from the Laidlaw-Dunn-Gordon 14-in. by 20-in. by 9-in. by 18-in. compound pump, and the 18-in. by 9-in. by 19-in. simple

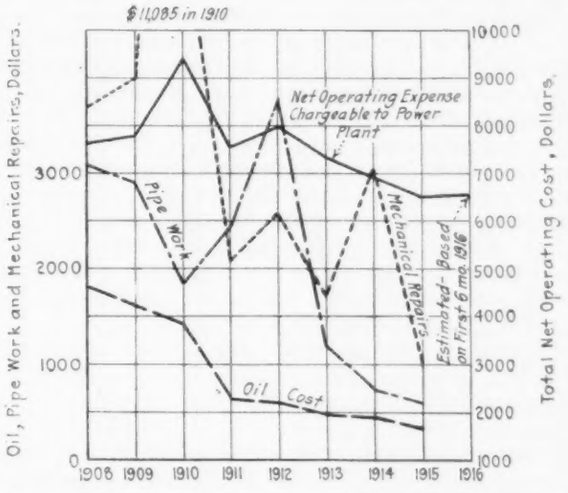


FIG. 1—OPERATING EXPENSES CHARGEABLE TO CHICAGO DEPARTMENT STORE POWER PLANT

pump operating the nine hydraulic elevators in the department store building, but in warmer weather there is no demand for heating steam, and the steam pumps, if operated then, must be run with a gross waste of energy. It was therefore decided to install three automatically controlled 55-hp. direct-current, motor-driven, 400-gal. per minute, three-stage turbine pumps and connect them into the high-pressure water system to supply the water during non-heating months.

To suit the conditions of the weather, the elevator

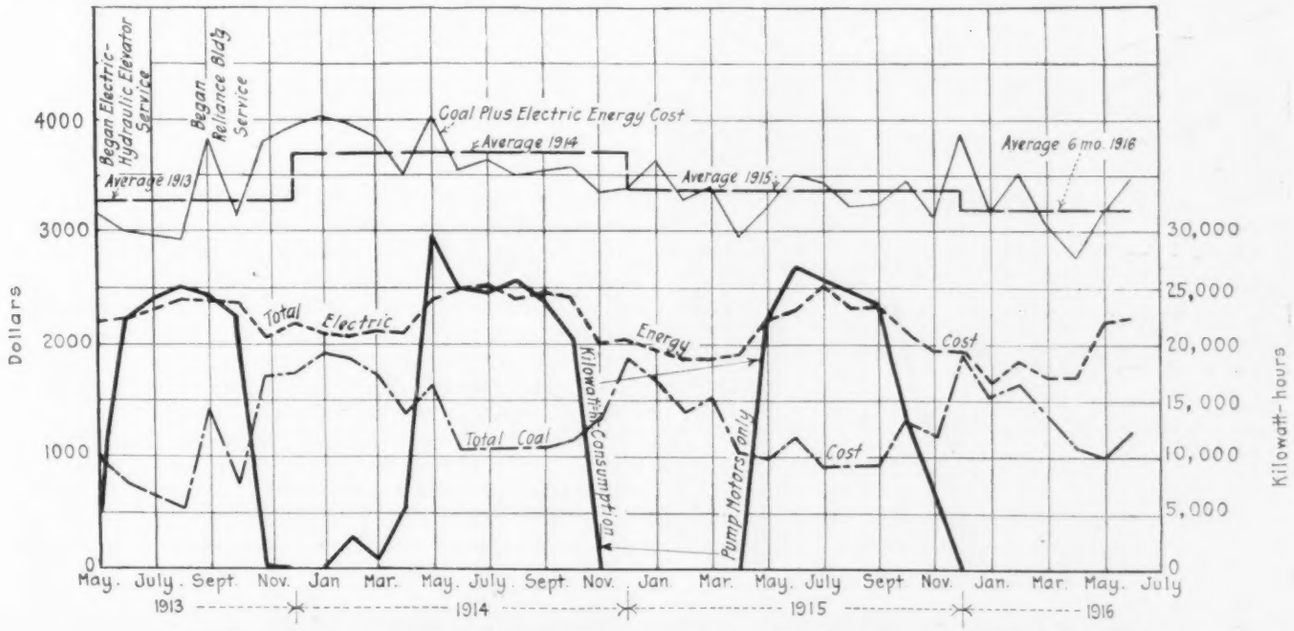


FIG. 2—PURCHASED ENERGY AND ISOLATED PLANT COAL COSTS FOR CHICAGO DEPARTMENT STORE

water pressure is supplied by the steam pumps or the electric pumps, with a resulting saving as indicated by the curves of Fig. 1. Here the cost of the mechanical repairs, of pipe work, and of lubricating oil are plotted in curve form to show the general downward tendency of some of the items which go to make up the total operating expense and give it a downward trend—due to the use of the electric equipment. During the years 1908 and 1909 the old steam equipment was in use. During 1910 the old boilers were replaced with new ones and the whole plant rebuilt, thus accounting for the high peak in the mechanical repairs cost curve for that year. In March, 1911, the company began to use central station service for lighting and for driving some small equipment, and discarded the small steam-driven generators, etc., mentioned above. This, of course, eliminated a large part of the mechanical repairs and a large part of the oil consumption, as indicated by the 1911 points on these two curves. In December, 1912, the ice machine and brine pump were electrified, and in April, 1913, the lighting of the first floor and basement of the adjacent building was put on the department store meters, which, of course, makes the points of the curve higher by $35 a month than is justly chargeable to the department store plant for this comparison. In May, 1913, the electric pumps for the nine hydraulic elevators were installed and the downward trend of the operating expense curve since then is continuous in spite of higher unit coal and labor costs.

The curve of kilowatt-hour consumption of the electric-driven pumps in Fig. 2 shows how the steam and electric units are alternated with the seasons, and the total energy and coal cost curves show the variation of these with the seasons in inverse relation to each other. The costs of power and coal are added together and their sum plotted in a curve to show the downward trend of their joint cost as the result of alternating the steam and electric pump equipment. The monthly figures vary considerably because of the irregularity in receipt and payment of coal, but the average-for-the-year curve shows a consistent downward trend. The installation of the electric elevator pumps, of course, added considerable to the kilowatt-hour consumption

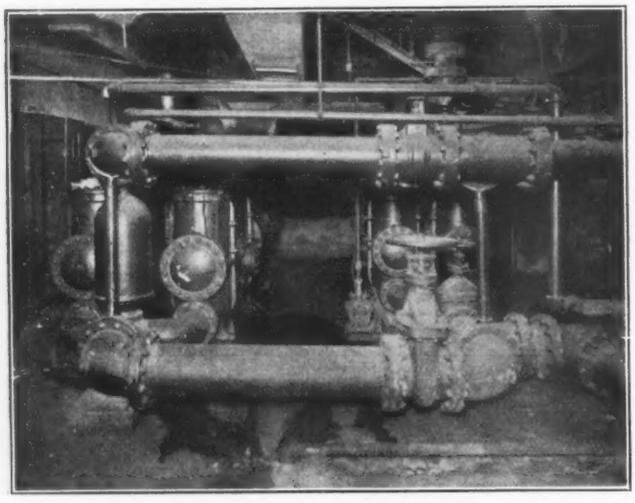


FIG. 3—STEAM PUMPS OPERATED DURING WINTER TO SUPPLY WATER PRESSURE FOR HYDRAULIC ELEVATORS

of the department store plant, but the cost of this is not proportionate to the increase for the reason that, due to the diversity factor, the pumps added only 35 or 40 kw. to the maximum demand and helped to earn a better rate for the entire plant consumption.

The coal cost curve includes the requirements of the adjacent building for heating and equipment mentioned above, and for this service the department store receives $500 a month, which was the actual coal cost of the adjacent building plant before it was shut down. This $500 a month, then, being bare cost and no profit, should be credited to the coal cost curve and the coal and electrical energy cost curve to make that much better showing for the combined winter and summer

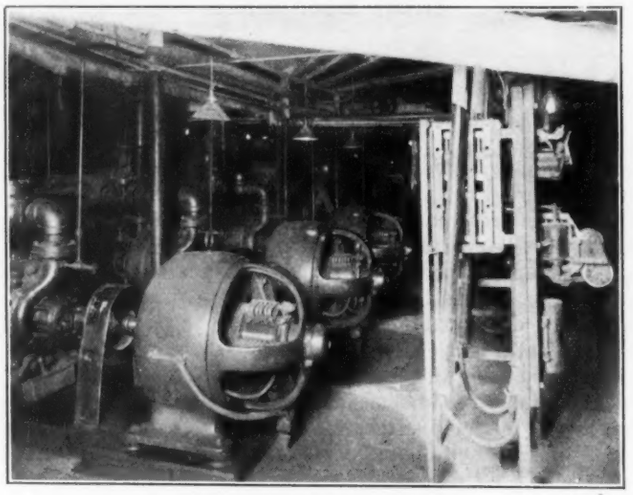


FIG. 4—THREE MOTOR-DRIVEN PUMPS FOR HYDRAULIC ELEVATOR OPERATION IN SUMMER AND FOR EMERGENCY USE

operation of the department store steam-electric plant. Since the end of the period included in these curves the condensate has been brought back to a hotwell from all traps and condensation points, whereas none of it was returned to the boilers before and all this heat was lost. This has also greatly assisted in reducing the amount of coal required.

The combination use of the steam and electric pumps has several advantages in a plant of these characteristics. The first, of course, is the substantially better economy. The second is that a standby equipment is thus always ready for emergency. A third advantage is that by shutting down the steam pumps in summer a large part of the heat thrown out into the basement and radiated throughout the whole store is eliminated, while in winter the reverse is true.

The data contained in this article and presented in curve form were supplied by G. J. L. Janes, general manager of the Hillman department store, Chicago, Ill. The engineering of the installation was done by C. J. Carlsen of the Commonwealth Edison Company and Fred Below, chief engineer of the department store.

Separating Underground Cables from Steam Lines

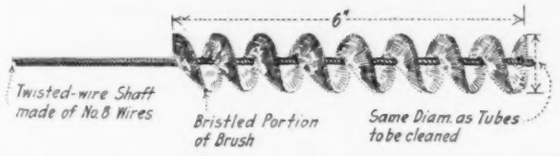
When electric cables must be installed in the vicinity of underground steam lines care should be taken to lay them as far above and to one side of the latter as possible. This is important since heat radiation from the steam lines will reduce the current carrying capacity of the cables or may disintegrate the insulation. Furthermore steam blowing against fiber conduit not incased in concrete tends to render it soft and pulpy. When the temperature of paper insulated cables has exceeded 100 deg. C. for a considerable time it has been found that the insulation will fall off in a fine powder if the sheath is removed. By placing the cables to one side of the steam line the probability of disturbance is minimized when the steam mains must be repaired. A separation of 2 ft. or 3 ft. from steam lines has been found very satisfactory by J. A. De Remer of New York City.

STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Cleaning Condenser Tubes with Fiber Brushes

Fiber brushes have been found very satisfactory by the Hartford (Conn.) Electric Light Company for cleaning condenser tubes, according to F. M. Wilbraham, power superintendent of the company, since they are stiff enough to remove slime and yet do not wear out the tubes like metal brushes or a sand blast. These brushes are constructed like ordinary gun-cleaning brushes, being made of fiber bristles held radially by a central shaft made of twisted No. 8 wires. The bristled portion of the shaft is 6 in. long and has a



CONSTRUCTION AND DIMENSIONS OF CONDENSER TUBE BRUSH

diameter equal to that of the tubes cleaned. When the condensers are cleaned once a week with these brushes, as much as 10,000 sq. ft. of tubes can be scrubbed in a day and a half by two men. Some idea of the quality of the circulating water may be obtained from the fact that about 4 tons of suspended matter pass through the 10,000-sq.-ft. condensers per hour, according to rough tests. Probably a considerable part of this deposit is sewage, as an intercepting sewer discharges above the plant into the river from which circulating water is obtained. During high water the tubes do not have to be scrubbed so often, as the suspended matter is more diluted.

How a Kite Was Used in Stringing Conductors Over Rapids in Mohawk River

BY LOUIS C. HYATT

In the construction of one of its 12,000-volt transmission lines, the Cohoes Company, of Cohoes, N. Y., found it necessary to run a line across the Mohawk River at a point about a quarter of a mile below the Cohoes Falls. The width of the river at this point is approximately 800 ft. and the banks on both sides are nearly perpendicular walls of rock about 100 ft. high, commonly referred to as the Palisades of the Mohawk. The rapids at this point of the river make the water ordinarily swift and unnavigable and on account of the high water the river was even more dangerous so that the usual method of carrying a line across in a boat was not considered feasible. The nature of the banks and their condition due to ice and snow made the method of crossing at a point above or below and then carrying the line along the banks to the desired point impractical, and as the line had to be built at once it was necessary to devise some other means of carrying conductors across the river.

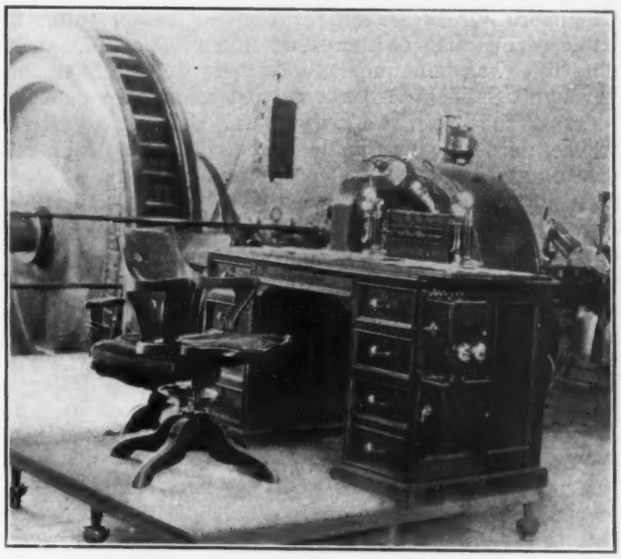
The use of a kite was suggested by S. F. Allan, superintendent of the company, and proved most satisfactory. After a few preliminary experiments to determine the type and proportion of kite that would give sufficient lifting capacity and least trouble in flying, the following construction of a box-kite was employed: The frame was made of wooden strips 0.25 by 0.25 in. in cross-section cross braced and firmly guyed with stout fish line. Unbleached cotton 12 in. wide was used for the covering. The dimensions of the kite were 42 in. long, 29 in. wide and 14.5 in. high.

This kite was taken to the roof of a long factory near the river bank and a running start was made with about 75 ft. of line, as it was found that at about that distance above the roof there was a steadier current of air. A neighboring smokestack indicated when the wind was blowing in the right direction to carry the kite directly across the river. Only a gentle breeze was blowing, but as soon as the kite struck the steady current of air above, it was carried across without any difficulty.

Two linemen on the opposite side of the river waited on the edge of the cliffs until the line sagged within reach. About 1000 ft. of chalk line was attached to the kite and in order to make this sag within reach of the linemen a few hundred feet of cotton banding was fastened to the end of the chalk line and allowed to be carried over the river. As soon as the line was caught by the linemen it was a comparatively simple matter for them to draw the cotton banding across the river and with this to pull over a 0.25-in. hemp line. This hemp line was used to draw over a 0.25-in. messenger cable which in turn was used to draw over the 4/0 copper cable for the transmission line.

A Scheme That Makes Telephoning Safe for Hydroelectric Plant Operator

By mounting the chief operator's desk on a platform carried on eight pin-type line insulators, as shown in the accompanying illustration, safe telephoning is



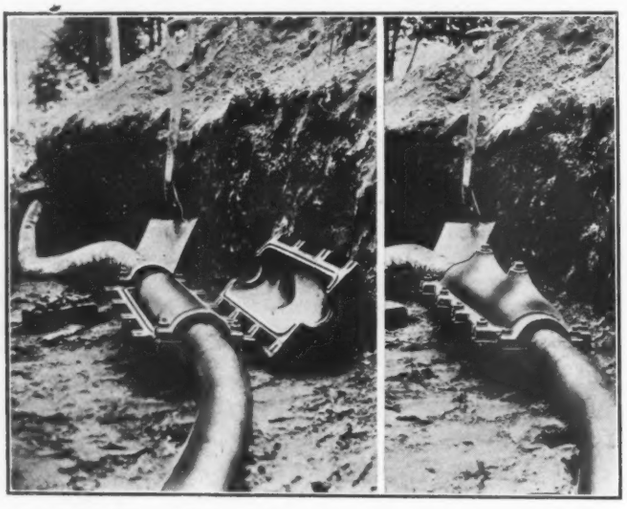
OPERATOR'S DESK MOUNTED ON INSULATED PLATFORM

greatly furthered in a Maine hydroelectric plant near Portland. By this arrangement no rubber mat was required, and as little noise is made by the machinery when the plant is in service, it was not considered necessary to provide a booth for system telephone communication. This scheme might be carried out in substations where the operator must use a telephone connected to telephone circuits carried on transmission line towers and there is trouble occasionally from induced voltages.

UNDERGROUND TIE-LINE LAID IN BARE EARTH

How a Saving of 42 Per Cent Was Made by Massachusetts Company by Laying Cable Without Ducts

An interesting underground tie-line of two circuits has recently been completed by the Greenfield (Mass.) Electric Light & Power Company between its steam plant in Greenfield and the hydroelectric station of the Turner's Falls Power & Electric Company at Montague City. This line is composed of two 3-conductor cables, each 11,100 ft. long, having a rating of 2,800 kw. at 80 per cent power-factor and 13,200 volts, and of 5300



CABLE JUNCTION BOX USED ON TIE-LINE SHOWN OPEN AND CLOSED

kw. at 80 per cent power-factor and 25,000 volts. When the operating pressure is raised to 25,000 volts, the cable rating may be increased to a total of 10,600 kw. The line was laid under the streets of Greenfield and through a trench across a rugged hill on the southern side of the town, thence to the Connecticut River, where a crossing was made in the river bed to the generating station of the Turner's Falls company. It forms a cut-off route compared with possible overhead routes between the two stations. The cables are at present operated at 13,200 volts.

Each cable consists of three No. 10 stranded copper conductors, each conductor being insulated with 9/32-in. varnished cambric, the three insulated conductors then being laid together and incased in 9/32 in. of varnished cambric overall. This overall insulation is incased in ⅛-in. lead sheath, which is inclosed in ¼ in. of jute, surrounded by two thicknesses of steel-band armor, the whole being wrapped in ⅛ in. of jute. The river crossing, which is 1,500 ft. long, required submarine cable. This is similar to the land line except that thirty-six No. 4 galvanized steel armor wires are used on the cable in place of the flat steel bands as extra armor and to give the cable more tensile strength.

On land the cable was laid without ducts in a trench 2 ft. deep and 18 in. wide in ordinary earth, and 18 in. deep and 18 in. wide where it passed through rock. In crossing the river a trench 2 ft. deep was dug in the bottom of the stream, and the cable covered with gravel and sand. At both banks the cable was anchored with concrete and buried anchors.

The total investment in the installation was $32,-419.88, which is about $2.92 per foot of double circuit, or $1.46 per foot of cable. The cost of using ordinary lead-covered cable in concrete conduits would have been about $13,875 in excess of this amount, or about 42 per cent more. In addition, it was possible to lay the cable in 1,000-ft. lengths, whereas cable laid in conduit could not have been laid in more than 250-ft. to 300-ft. lengths, so that there would have been at least three times as many joints had the conduit method been used. By the use of the new line the Greenfield steam plant need not be operated except at a good load-factor.

Generation and Distribution Expenses of a Middle West Company

The data in the accompanying tables show the annual generation and distribution expenses of an electric service company operating in a Middle West city of 50,000 inhabitants, and having 5500 consumers. Last year the maximum demand was 4400 kw. and the annual output 11,920,000 kw.-hr.

TABLE I—GENERATING COSTS FOR MIDDLE WEST STEAM STATION

Generation Expenses	Amount	Per Cent of Total Operating Expenses
Superintendence	$2,109.16	1.63
Boiler labor	5,287.06	4.11
Engine labor	4,042.77	3.13
Miscellaneous labor	59.06	0.05
Fuel	47,224.39	36.65
Water	8.60	0.01
Lubricants	327.63	0.25
Production supplies	309.87	0.24
Station expense	611.97	0.48
Repairs steam equipment	10,008.49	7.76
Repairs electrical equipment	209.96	0.16
Repairs station, buildings, structures and miscellaneous	303.92	0.24
Total generation expenses	$70,502.88	54.71

TABLE II—EXPENSES OF THE DISTRIBUTION SYSTEM

Distribution Expenses	Amount	Per Cent of Total Operating Expenses
Superintendence	$100.05	0.08
Wages	165.65	0.13
Setting and removing meters	969.45	0.75
Setting and removing transformers	437.70	0.34
Supplies and expenses	1,500.73	1.16
Repairs overhead lines	7,436.87	5.77
Repairs underground system	197.02	0.15
Repairs services	1,035.24	0.80
Repairs distribution transformers	308.97	0.24
Repairs customers' meters	3,549.51	2.75
Total distribution expense	$15,701.19	12.17

The utilization, commercial, general and miscellaneous expenses amounted to about 5, 14 and 14 per cent of the total, respectively. Fuel (36.65 per cent), repairs to steam equipment (7.76 per cent), boiler labor (4.11 per cent), and engine labor (3.13 per cent) constituted the larger items under generation expense, while repairs to overhead lines (5.77 per cent) and repairs to customers' meter (2.75 per cent) made up the principal part of distribution cost as shown by the data of the accompanying tables.

Results of Ground Tests Made on Distribution System

Under the supervision of J. E. Gossett, engineer of distribution for the Topeka Edison Company, a number of ground tests have recently been made in various districts of the company's distribution system where 1.25-in. by 6-ft. ground rods were spaced from 500 to 900 ft. apart. In districts remote from city water service, with no underground metallic pipe except private water systems extending from wells to buildings, fourteen readings were taken at various points along the line and the lowest resistance found was 8 ohms at a distance of about 100 ft. from a ground rod. The highest resistance was 4 ohms with the reading taken about 700 ft. from a rod and No. 6 secondary. The average of all the readings was 19 ohms. From fifty-five readings taken in districts in the city where city water service was available, the average resistance was about 4 ohms. The highest and lowest readings were respectively 13 ohms and 1 ohm.

The conclusions drawn from these data are that for districts remote from city water service the secondary should be grounded at the customer's premises in addition to the ground on the main. The result from districts with city water service showed a fair condition, but better efficiency of grounds could be secured by driving rods to a greater depth and spacing them at more frequent intervals.

Inexpensive Method of Utilizing Electricity to Prevent Water Tanks Freezing

Several stock raisers and dairymen at Goshen, Ind., have overcome the trouble they have experienced in cold weather with water tanks freezing by operating the pumps used in raising the water from wells just fast enough so that the warmer water of the supply source will maintain the water in the tanks at a temperature above freezing. Enough water is allowed to discharge from the bottom of the tank where the cold water settles to offset that added by the pump. This method of using electricity for operating a motor-driven pump has been found much less expensive than using electric heaters, as can be seen from the following computations:

Assume that a 1-hp. motor with 79 per cent full-load efficiency and a pump with 50 per cent efficiency are employed to raise water at 60 deg. Fahr. against a head of 40 lb. per square inch. Under these conditions, 0.5 of 33,000 ft.-lb. per minute (equivalent of 1 hp.) is available for raising water. Against the pressure mentioned, which is equivalent to a head of 92.3 ft., the pump will therefore discharge (disregarding pipe friction) $(0.5 \times 33{,}000 \div 92.3) = 178.6$ lb. of water per minute. If the water in the tank is maintained at 40 deg. Fahr., supplying water at this rate will add $178.6 \times (60 - 40) \times 60$ B.t.u. per hour, or 214,000 B.t.u. At the motor efficiency assumed this heat is added with an energy consumption of 746/0.79, which is 945 watt-hours or 227 B.t.u. per watt-hour. By using electric heaters only 3.4 B.t.u. could be added per watt-hour of energy consumed, thus showing that the motor-pumping method costs 1.5 per cent of heating by electricity.

In the above computations the value of the water wasted is disregarded. The pumps have to be used under any conditions for filling the tank, so that the interest on the investment and maintenance expense can also be neglected in comparing the total expense of preventing freezing by the pumping method and by the use of electric heaters.

This heating scheme for overcoming consumers' difficulties was devised by the Hawks Electric Company, which supplies electric service in and around Goshen, Ind.

Changes in Boiler Piping That Improved Steam Heating Service

At the Chase Court substation of the Worcester (Mass.) Electric Light Company a battery of four horizontal return tubular boilers aggregating 500 hp. supplies both live and low-pressure steam for local heating service in adjacent buildings formerly served by a block

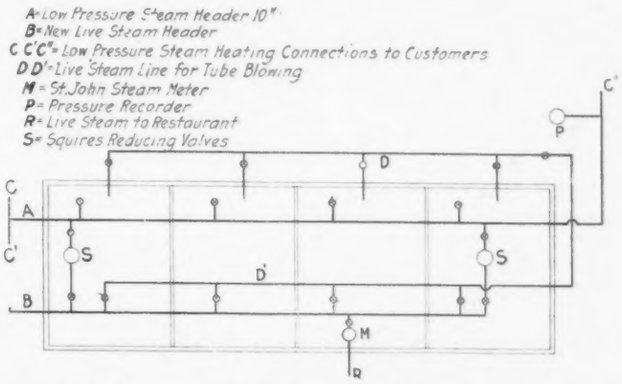


FIG. 1—PIPING OF BOILERS FOR HEATING SERVICE

plant. Some months ago the lighting company installed substation equipment at this point, shutting down the former high-speed non-condensing engine plant and utilizing the location as one of the most important downtown distribution centers on the heating system.

A recent demand for live steam from a new department store restaurant arose, and the lighting company was asked to set aside one entire boiler for this service.

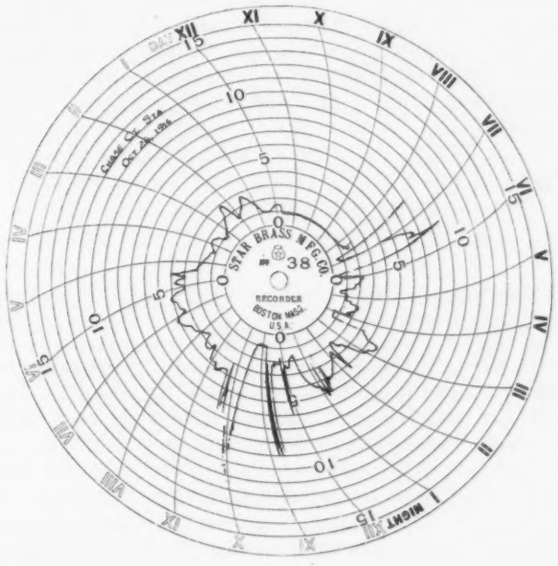


FIG. 2—VARIATIONS IN STEAM PRESSURE BEFORE INSTALLING NEW STEAM HEADER

The customer estimated his average steam heating load at 40 hp. Tests with a St. John steam meter have shown this load to be 27 hp. The lighting company did not feel that it could reserve a single boiler for so small a load, as the unit could be used to advantage in supplying the low-pressure steam heating service of the block at the same time. The problem was solved by

installing a new 4-in. main along the rear of the boilers, as shown in Fig. 1, and cross-connecting this at each end through a 4-in. Squires reducing valve with the 10-in. header which had been in service over the boilers in the past. By this arrangement live steam at 30-lb. pressure can be fed to the restaurant and to any future customers desiring it, while steam at 2-lb. or 3-lb. pressure, or less, is available for heating at all desired points. Under normal conditions a single boiler can supply the two classes of service and at maximum efficiency. Appropriate stop valves as indicated are installed to secure flexible operation.

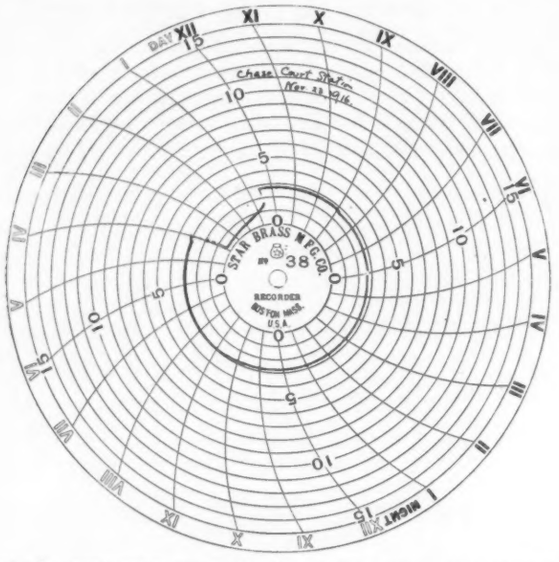


FIG. 3—PRESSURE ON HEATING MAIN AFTER CHANGES IN BOILER PIPING

Before the new main was installed, and after the engine plant was shut down, the boilers were operated at low-pressure only and the variations in pressure were serious, as shown on the chart reproduced in Fig. 2. Since the installation of the reducing valves and new header, the pressure regulation on the old heating main has been greatly improved, the results being indicated in Fig. 3. Hand firing is employed throughout, as before the change. The discharge from the reducing valve system is used as boiler make-up water, and city water at 140-lb. pressure is used as a balance on the auxiliary valve, this being helpful in maintaining steady pressure on the heating lines.

An Accident Due to Incorrectly Set Brushes

BY R. L. HERVEY

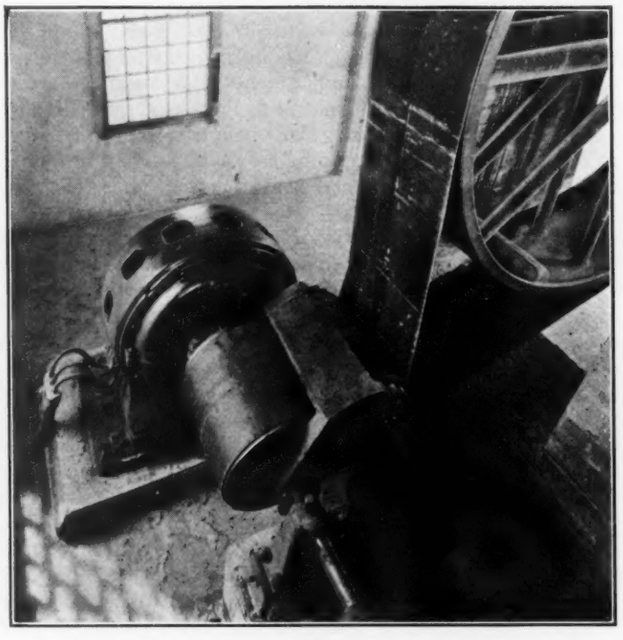
In a case where an isolated plant was furnishing a meat packer with electric power at 110 volts for a 10-hp. motor, in order to provide emergency service connections were made to the central station's 220-volt mains. The higher voltage required the installation of an additional motor with its separate starter. When the new 220-volt motor was installed no electrical test was made until the work had been completed and the belt put on the pulleys. With all the machines connected to the line shaft, the motor was started. One man observed that the speed was excessive and ran to the switch box, missing by about 6 in. a piece of the rim of a 36-in. iron pulley; another piece went through the roof. Before the motor stopped the line shaft was bent and the boxes thrown out of line by the unbalancing of the pulleys. The dealer who sold the motor was held responsible for the damage, and therefore had an examination made. The connections were found correct, but the rocker-arm was loose and the brushes were about 60 electrical degrees back of the neutral position.

Before the motor was started the brushes were set as closely to the neutral as could be by tracing out the armature leads. The line and armature wires were taken off the starter to test the magnetic switches, which were found to be working properly. The line wire was then reconnected and the shunt field tested and found complete by observing the flash when the switch opened and by holding an iron bolt against the field poles to test the pull of each pole. With the belt off, the brushes set approximately correct and a current in the shunt field, the armature connection was made and the switches closed, the motor started and ran as nicely as could be wished for. This little bit of carelessness in not testing the motor before putting on the belt caused a shutdown for seven hours, an expenditure of $24 in repairs and endangered the life of one man. It is needless to say that the dealer was relieved of all blame for the damage.

Short-Center Belt Drive and Emergency Control Arrangement

The accompanying illustration furnishes a striking example of how a belt drive can be used even when the distance between the rims of the pulleys is less than the radius of the larger one. This particular drive is installed in the plant of the Oregon Portland Cement Company at Oswego, Ore., and is used to operate a 22-ft. tube mill. Measured center to center the driving pulley and flywheel are only 7 ft. apart. The motor is a 250-hp. Westinghouse unit and with the Lenox drive employed a 24-in. belt is used.

Wiring for the motor is run in conduit buried in the floor. For starting the motor a dustproof compensator with an ammeter is used. This is mounted on a structural steel frame-work with switches controlling other motors in the same department. It may be pointed out that a 600-volt snap switch is provided on the cable terminal at the motor and connected with the low voltage release coil of the compensator by No. 14 duplex cable so that the motor may be stopped without the attendant going to the control panel. This emergency stopping arrangement is provided on all motors in the plant.



METHOD OF DRIVING PULLEYS ONLY 7 FT. APART

COMMERCIAL AND BUSINESS POLICY

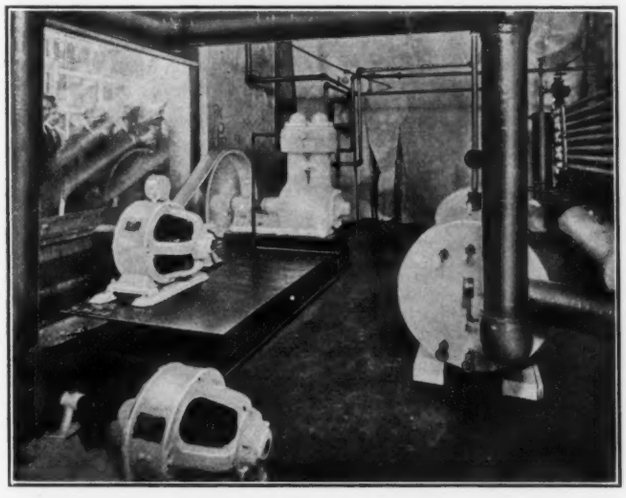
A Department of Plans and Methods for Widening the Application of Electricity and for Extending Electric Service

Realty Firms Equipping New Houses with Electric Ranges at Akron, Ohio

The Sumner Realty Company of Akron, Ohio, has contracted for the construction of sixty houses which will be built in what is known as the Lakewood Heights allotment, a new residential section of the city overlooking Summit Lake. In each of the thirty houses which have been completed to date, there is a Standard electric range and an automatic electric water-supply system. While the district is one which has not had utility service in the past, both the Northern Ohio Traction & Light Company and the telephone company have extended lines into the territory to serve the sixty houses covered under this contract as well as those built by other individuals. H. B. Bixler, superintendent of the lighting department for the central station company of Akron, declares that this is the first attempt that has been made in the city to install electric ranges when houses are built. The venture is meeting with such great success, however, that several other real estate firms have plans well laid for adopting the same scheme for speeding up house sales.

Portable Motor-Driven Ice Plant for Theater Skating Scene

It is one thing to stage an ice ballet in the New York Hippodrome, where the show runs for an entire season, and quite another thing to transport a skating rink around the country with only a short run in each place. When it was decided to send the Hippodrome Company



THIS PORTABLE REFRIGERATING MACHINERY MAKES IT POSSIBLE FOR A THEATRICAL COMPANY TO PRESENT ICE BALLET SCENES WHILE ON THE ROAD

on the road, keeping intact the entire spectacles of "Around the World," including the ice-skating scenes, one serious drawback was the problem of furnishing a suitable ice pond. The adoption of the ice plant shown by the illustration proved to be the solution. The various units of this plant are transportable, each being mounted on a skid or stand, so that when the show closes it is only necessary to take down the piping, haul the different pieces of apparatus, on a truck, pack them into a car and ship to the next showing place. To avoid the loss of time required to erect the plant and freeze the water, which takes twenty-four hours, duplicate outfits are used. While one is working in one city the other is being set up at the next point, so that everything is in readiness when the company arrives. The first plant then goes to the next succeeding point.

Each plant consists of a 10-ton York compressor, with two cylinders each 6.5 by 6.5 in., driven by a 20-hp. direct-current Westinghouse motor, and a 60-kw. Westinghouse motor-generator set. Where direct current is available, the motors are operated from the power-circuit, but since usually only alternating current is to be had, the motor-generator set is used to transform the alternating current into direct current for the operation of the motors.

The brine tank has a capacity of 1900 gal. The ice pond formed on the stage is 45 ft. long, 20 ft. wide, and 4 in. deep. While being frozen, the water is held in place on the stage by a canvas tub.

CO-OPERATIVE CAMPAIGN SUCCESSFUL IN INDIANA

Eight Solicitors Working Four Weeks in Six Communities Sell 1006 Appliances, Having Connected Load of 516 Kw., Which Will Produce Revenue of $7,200 a Year

At Newcastle, Shelbyville, Columbus, Seymour, Bloomington and Bedford, Ind., cities served by the Interstate Public Service Company, a co-operative campaign recently conducted proved to be a great success. In this campaign one of the large manufacturers arranged for the solicitors, and in return was paid by the Interstate Public Service Company a certain portion of the discount on the merchandise which in turn was used to pay the solicitors. The Interstate Public Service Company also paid for the advertising incidental to the campaign.

At the outset, the solicitors received specially prepared data cards containing the names and addresses of all of the company's patrons. From these cards, which were made on the company's addressograph, the commercial customers were eliminated, and the cards were arranged so that the solicitors could follow the meter readers' routes. This offered a quick and convenient way of covering all of the territory. Each man was expected to handle eighty data cards per day, and it was found that a solicitor could very easily take care of this amount of work. The solicitors worked one week in each of the larger cities, and for the smaller towns the crew was divided with four men to a town, so that the entire six communities were handled in four weeks.

CAMPAIGNS USUALLY BEGUN ON MONDAY

On the Thursday before a campaign was begun letters were mailed to the residence customers announcing that a solicitor, representing the electrical manufacturer and the local lighting company, would call. No mention was made of the Interstate Public Service Com-

pany for the reason that it is not believed to be good policy to use the name of the general utility company when dealing with the patrons in an individual town. The announcement of the campaign was also made in advertisements on Thursday, Friday and Saturday.

When the campaign began each solicitor carried a black traveling bag in which was a sample iron, toaster, percolator, curling iron and toaster stove. The solicitors were instructed to say upon arriving at the customer's house, "I am a representative of the Westinghouse company and the lighting company from which you received a letter last week. I have come to demonstrate the electrical appliances mentioned in the letter." The solicitors found no trouble in securing audiences.

LARGE SALES MADE, FEW GOODS RETURNED

As a result of this rapid-fire campaign 1006 pieces of merchandise were sold in the six towns, which produced a net connected load of 516 kw. It is estimated that the revenue from these devices during the first year of their use will amount to $7,200. A large part of the equipment sold was toaster stoves and irons. All goods were sold at list, time payments being offered to customers with good credit.

O. F. Abrahamson, new-business manager for the Interstate Public Service Company, said that in his opinion the campaign had been a success simply because all details were carefully worked out and because the crew manager was an expert in his work and had made wise selections in choosing solicitors. It was a notable fact that from each town no more than three appliances were returned after the campaign was finished. That there was no dissatisfaction is attributed to the fact that each appliance was delivered on the day following its sale. Strict observance of this principle reduced cancellations to a minimum, and imparted to the customers the idea that the company was giving real service. The campaign has also had the effect of stimulating sales of other devices not made a part of the campaign.

To fully capitalize the interest created, each customer was sent a letter containing five coupons just after the sale was over. Each of these coupons entitled the purchaser to a 10-per cent discount on the purchase of other goods, if presented at the time of the purchase. The letter also stated that if the appliance purchaser could induce a neighbor to buy an appliance, she herself would be entitled to the 10-per cent discount on the friend's purchase. The campaign is the first electrical appliance sale which has been a complete financial success in these cities.

Twenty-One Hundred Baltimore Customers Hold 13,000 Shares of Company Stock

At Baltimore, Md., in the spring of 1915 the Consolidated Gas, Electric Light & Power Company announced a plan to offer stock to its customers and so give them a closer interest in the activities of the company. Accordingly letters were sent out describing a plan which offered one to twenty shares of stock to customers on a basis of time payment. For each share purchased a monthly payment of $4 was to be made with the electric bill. The company promised 6 per cent quarterly compounded interest on the payments, and in case a subscriber desired to withdraw from the plan at any time interest was promised on his payments to date of withdrawal at 4 per cent per annum.

During the first month of this offer 720 consumers signed for 3019 shares at $106.50 a share. Since that time 1380 other customers have taken advantage of the offer. In all 13,767 shares have now been subscribed for in this way, individual customers taking from one to the maximum allowance of twenty shares.

The aim of the company is to offer the stock to customers at or about market prices, and the price is ordinarily fixed on the 10th of each month for a thirty-day period. On Nov. 10, 1916, for example, the announced price was $120 per share, and although the market price of the stock rose 10 points after the announcement, the company continued its offer until the 29th, when an advance was announced.

Placing the Engineer of the Superseded Isolated Plant

A central station salesman in a Kentucky city was recently enabled to sell motor drive and central station service to a packing house which had been using a private steam plant by finding a way in which the owner could profitably retain his engineer.

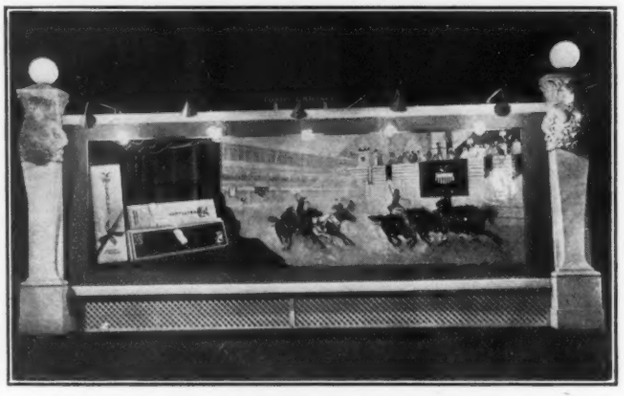
The packing-house proprietor operated a 5-ton steam-driven refrigerating machine, a 10-kw. steam-driven generator and a steam pump. The salesman succeeded in convincing the owner of the economy of electric drive, but as the daily run of the plant was only about five hours, the owner felt that it would not pay to keep the engineer to start and stop the motors and handle the little maintenance work connected with them.

The salesman found, however, that the packing house had in use a fleet of motor trucks and so he proposed the installation of a work bench in the former engine room and suggested that the ex-engineer be given complete charge of the truck repairs as well as the handling of pipe-cutting and threading jobs about the plant.

This scheme worked out to the complete satisfaction of all concerned, and instead of being laid off the engineer was given a raise with his new duties. In the words of the power salesman, "While the slide-rule played a part in paving the way for the deal, common sense was the factor which closed it."

The Electrically-Lighted Billboard as a Long-Hour User

The electrically-lighted outdoor sign offers a long-hour load which is being developed by many central stations. The sign illustrated is a particularly high class of signboard work in which the color and detail



ELABORATE ELECTRICALLY-LIGHTED SIGNBOARD AT TACOMA, WASH.

have been worked out with great care. This sign is in constant use in Tacoma, Wash., and carrying as it does two pedestal lamps in addition to its five flood-lamps, the sign represents an appreciable addition to the annual income of the lighting company.

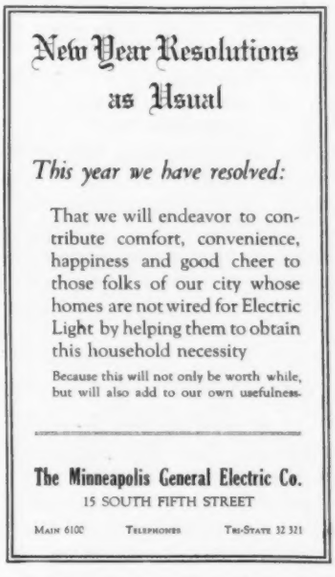
Lighting a Wallpaper Display Room

Until recently the salesroom of "the store which sells Cincinnati its wall paper" was lighted by gas. But through the efforts of the lighting squad of W. A. Wadsworth of the Union Gas & Electric Company, this has all been changed. The gas-mantle lamps which formerly supplied the general store illumination as well as lighting for the swinging display panels have been removed, and the general lighting is now done by 300-watt lamps in 12-in. round diffusing globes, and localized lighting is employed for the movable display panels. One of the units for the latter service is shown herewith alongside the gas lamp which was displaced. The effect of the scoop reflector in directing the light on the swinging display panels is apparent from the picture. These units, each equipped with a 100-watt lamp, are placed along the wall on about 12-ft. centers. Each is controlled by a pull-chain switch so that as the prospective customer moves from panel to panel, the wallpaper clerk can keep the illumination focused on the particular display which interests the purchaser.

SCOOP REFLECTORS USED TO LIGHT WALLPAPER DISPLAY PANELS

Mailing New Year Resolutions to House-Wiring Prospects

On the last day of 1916 each of 1000 carefully selected house-wiring prospects in Minneapolis, Minn., found a green postcard in his mail. The address side of the card carried New Year greetings in a neat panel. On the back of the card a New Year resolution set forth the company's ambition to bring convenience to all dwellers in unwired houses by installing electric service for them.


New Year Resolutions as Usual
This year we have resolved:
That we will endeavor to contribute comfort, convenience, happiness and good cheer to those folks of our city whose homes are not wired for Electric Light by helping them to obtain this household necessity
Because this will not only be worth while, but will also add to our own usefulness.
The Minneapolis General Electric Co.
15 SOUTH FIFTH STREET
MAIN 6100 TELEPHONES TRI-STATE 32 321

Company's Sign Preceded Launching of Local Sign Campaign

In undertaking an electric-sign campaign the United Illuminating Company of New Haven, Conn., adopted as its first move the installation of a sign of its own on the roof of the Chamber of Commerce Building. The sign measures 50 ft. by 24 ft. and has a total rating of 16,240 watts.

It was not until this sign had been in operation two weeks that the general sign campaign was actively launched. The merchants were thus given an opportunity to discuss the sign and think of its application to their own businesses. To this feature alone the company attributes much of the success of the campaign. The added load already secured through the installation of new signs will pay the cost of the campaign, including the cost of the company's own sign, in less than a year. Much value is attached by the company to the fact that the business men of the city have thus been led to discuss the proposition among themselves.

AS A FIRST STEP IN ITS SIGN CAMPAIGN, THE NEW HAVEN COMPANY PUT UP THIS DISPLAY OF ITS OWN EQUIPPED WITH 1624 10-WATT LAMPS

Electric Immersion Heaters Used in Oil Bath for Lumber

One of the unique electrical installations for which the Commonwealth Edison Company of Chicago furnishes service is a set of electric heaters in an oil tank used for treating lumber. The tank measures 10 ft. by 8 ft. by 12 in. wide and carries an auxiliary oil reservoir above the main tank, which has a capacity of 15 cu. ft.

The 100 gal. of oil contained in the main tank are heated by six 4800-watt immersion heaters placed at the bottom of the container. By means of automatic temperature control any desired degree of heat can be maintained in the tank, and heat economy is obtained by the placing of the auxiliary reservoir above the main tank to absorb the radiation. Fifteen 6-in. by 4-in. timbers may be treated simultaneously, and the outfit has a capacity of sixteen pieces an hour.

ADVANCE IN TECHNICAL THEORY AND PRACTICE

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RELATION BETWEEN TENSION AND MAGNETIC PERMEABILITY

Abstract of a Paper Presented Before the Engineering Section of the American Association for the Advancement of Science at New York, Dec. 29, 1916

BY JAMES THERON ROOD
Professor Electrical Engineering, Lafayette College, Easton, Pa.

THE permeability curve found for a given magnetic material is commonly assumed to hold for that material irrespective of the conditions under which the given material is to be used. Is this correct? For example, will the permeability curve found for a certain armature or transformer iron hold when the material is in actual use in an armature or transformer? The armature iron in use is subjected to (1) compression along the armature between the end plates; (2) tension acting radially outward, produced (*a*) by centrifugal force arising from rotation, (*b*) by magnetic pull between field poles and armature. The transformer laminations are subject to mechanical compression, and doubtless also to extensional strains due to magnetic pulls. In each case there exists one or more mechanical forces acting upon the given material.

Three questions at once arise: 1. Does mechanical strain affect the magnetic permeability of a material? 2. How does this change with the kind or quality of the magnetic material? 3. What is the order of magnitude of it?

Again, curves between magnetizing force and magnetic induction for ferrous materials are strikingly similar in form to the curves between unit mechanical stresses and unit deformation for the same materials. The first parts of both curves are alike; that is, stress is proportional to the deformation producing it, magnetic induction is proportional to the magnetizing force bringing it into existence. Above a certain point each curve bends abruptly, forming a knee, indicating that great increases in deformation are required to produce relatively small increases in stress, and large increases in magnetizing force are required for relatively small increases in magnetic density. The comparison may be carried further with cast iron and wrought iron. For wrought iron both curves have a steeper slope from the origin than the corresponding curves for cast iron. The same conditions hold true beyond the knee.

From this it would appear that there must be some similarity, relation or connection between mechanical tension and magnetic permeability. The relation seems, however, to fail when non-ferrous materials are considered. These have stress-deformation curves similar to those of ferrous materials, but do not have the same $B - H$ curves. The explanation, when found, will doubtless be a molecular one.

In order to study the influence of tension upon the magnetic properties of cast iron, wrought iron and steel, the writer has had a number of tests made in order to secure data that would provide answers to each of the three questions propounded. A 100,000-lb. Riehle machine was used for loadings. The elongations were determined with a Riehle extensometer. The specimens had a standard section of 1.32 sq. cm. The Hopkinson ballistic-reversal method was employed. A U-shaped yoke, 5 by 5 cm. in section, was used to carry the magnetizing coil, being firmly clamped to the specimen by two end pieces, each carrying four wing nuts. The magnetizing coil carried 2000 turns of No. 20 wire. The test coil was wound on brass tubing and was held concentric with the specimen by three set screws. The turns on this coil could be varied from five to eight. The yoke was calibrated with a known specimen.

The conclusions from these tests are as follows:

Cast iron is unaffected in its magnetic properties by stresses.

Wrought iron and steel are greatly affected in their magnetic properties by extensional stresses. This effect, however, is not a constant but varies in both sign and magnitude, according to amount of stress and to degree of saturation. Below the knee of the $B - H$ curve, permeability of wrought iron and steel is increased by all stresses below a certain maximum, this maximum varying with the material. This increase may be as high as 20 per cent. For stresses beyond this maximum, the permeability is decreased up to the elastic limit of the material. This decrease may reach 15 per cent.

Above the knee of the $B - H$ curve permeability of wrought iron and steel is decreased by any extensional stress. This decrease may reach a value of 8 per cent or more. Its value diminishes as the degree of saturation increases. With rolled material the effect of tension on magnetic properties increases as the elasticity decreases. Cast iron is an exception.

Considered from standpoint of the free and combined carbon present in the material, the results of the tests made fall naturally into the ascending scale of cast iron, steel, wrought iron. The carbon molecules or particles may act as filler or cement, thus preventing the free action of the pure iron molecules.

If it is assumed that the effect of tension is, first, to twist the molecules so as to bring their axes toward parallelism with the direction of the stress; second, to tend to separate the molecules, the reversal effect at low stresses can be accounted for. The results here given cover certain specimens under tension. It would be desirable to extend the list of specimens and to study their action under compression as well as under extension, and I trust that those having the facilities may carry on this work and extend its scope.

Generators, Motors and Transformers

Manufacture of Armature Coils.—D. W. Perry.—An article comparing the relative advantages of molded, formed and pulled coils. The cost of the coils is reduced by the use of the puller and shorter delivery dates are possible. Further, the puller permits the use of shapes of conductors that are impractical on the molds and formers. Soldered joints inside the coils may be avoided in many cases by the use of the pulling machine. On the other hand, the former gives a more accurate coil, requiring a slightly shorter mean length of turn, thereby saving in copper. Irregular-shaped coils can be

made on a former that would be impossible on the puller. The mold must be used for one-coil-per-slot windings and for concentric windings. It is also used to an advantage on very small coils for small motors. It is generally advantageous to use a former or a puller for all other cases.—*Elec. Journal*, January, 1917.

Lamps and Lighting

Hue Difference and Flicker Photometer Speed.—HERBERT E. IVES.—A brief account of an investigation carried out in the physical laboratory of the United Gas Improvement Company of Philadelphia. The critical speed of the flicker photometer at its equality setting has always been considered and treated by the author as a function of the hue difference. Critical speeds for the spectrum, compared with a carbon lamp standard, published some years ago, showed a minimum in the yellow, which was ascribed to the hue distance between the yellow carbon lamp and spectrum at that point being smaller than at any other point. Recently Troland has obtained similar curves which he interprets as being reciprocals of the luminosity curve, on the ground that the low critical speed means greater whiteness, which he identifies with brightness. The present author has developed the exact relationship between speed and hue difference on the basis of the theory recently developed and confirmed by experiment. It follows from this theory that the minimum critical speed in comparing the spectrum against any colored light occurs at the wave-length, which is distant from the spectrum the least number of hue steps. If the comparison lamp is red, the minimum speed is in the red, if blue, in the blue, if yellow-white, in the yellow, but with a much higher speed at the blue than at the red end, while for a true white (5000 deg. black body) the curve is symmetrical about a minimum in the green. The hue distances were worked out from the color sensation and hue difference data of Koenig and Steindler. The experimental work was carried through with the new polarization flicker photometer, fitted to a constant deviation spectrometer. Curves of the predicted type were found in each case. Since the luminosity curve remains fixed, no matter what the color of the comparison lamp, these speed curves, with their minima occurring at any point one desires in the spectrum, show the "reciprocal of the visibility curve" idea erroneous.—*Journ. Franklin Inst.*, December, 1916.

Units, Measurements and Instruments

Measuring Feeble High-Frequency Currents.—BELA GATI.—For measuring feeble currents of high frequencies, such as used in telephonic or wireless telegraphic work, barretter coils, B and B_1 in a balanced bridge circuit are useful, as shown in Fig. 1. The high-frequency current to be measured is applied from the terminals CC to one of the two barretter coils B_1 only, while a weak direct current from the batteries AA passes through both barretters B and B_1 in series. The inductances DD prevent the high-frequency current from passing through other parts of the circuit except B_1. R and R_1 are a coarse and a fine rheostat for producing balance at the beginning of the test. When the high-frequency current is then closed on CC (through a condenser preventing the direct current from passing into the high-frequency circuit), the balance of the bridge is disturbed by the heating of B_1 and the deflection of the galvanometer G is a measure of the high-frequency current. Barretter wires, 0.0005 mm. in diameter, can be used without difficulty, but are too fragile for transportation by mail. The barretter wires are mounted in metallic capsules from which the air is not exhausted. Small tungsten-filament lamps are suitable for "wireless" measurements. Fig. 2 shows the connections of an apparatus in which a number of barretters is employed. When using the tungsten barretters, only the latter must be connected in each half of the bridge. It is not difficult to manufacture tungsten and other resistances with such accuracy that the microammeter shows no deflection in a bridge initially balanced, when the position of the barretter selector switch is changed. Barretters not in use should be short-circuited (Fig. 2) unless very high frequencies have to be measured; in this case there is a danger of current being induced by higher harmonics in short-circuited barretters; the solution indicated by Fig. 3 may then be used. Coils 1, 2, 3, etc., are of small inductance sufficient to obstruct the flow of very high-frequency current such as is used in wireless work. Connections are made to the barretters by jacks I, II, etc.—From *L'Industrie Elec.*, translated in London *Electrician*, Dec. 15, 1916.

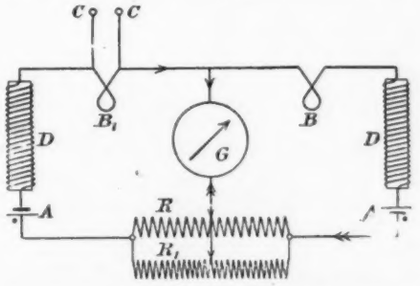


FIG. 1—METHOD OF MEASURING FEEBLE HIGH FREQUENCY CURRENTS

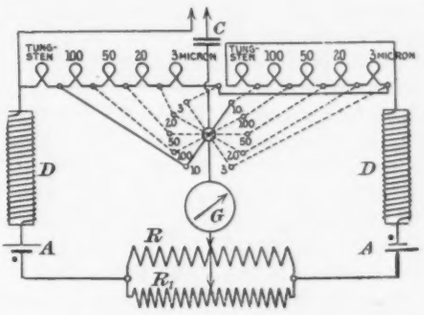


FIG. 2—USE OF TUNGSTEN BARRETTERS

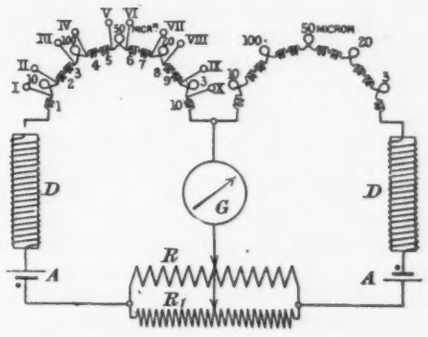


FIG. 3—METHOD OF CONNECTING BARRETTERS BY JACKS

Telegraphy, Telephony and Signals

High versus Low Antennæ in Wireless Telegraphy.—EDWARD BENNETT.—Present practice is to mount the extended capacity of an antenna, or at least a large part of it, at a great elevation above the earth. The author subjects this practice to a critical examination. The electric and magnetic forces set up at a great distance from an extended horizontal network of wires are discussed. It is shown that if the radius of an antenna

consisting of a horizontal network of wires is two or three times as great as the height of the network above the ground, the electric and magnetic forces at a great distance from such a radiator are practically independent of the height of the network above the ground, provided the frequency of oscillation and the operating voltage from the network to ground are kept the same for the different mounting heights. That is to say, an extended network of wires charged to a given voltage and allowed to discharge to earth through an inductance tuned to give a frequency of say 100,000 cycles per second sets up the same electric and magnetic forces at distant points whether mounted 10 ft. or 200 ft. above the ground. In these two cases the rate of radiation (in kilowatts) from the two antennæ is the same, but the initial store of energy in the case of the 10 ft. mounting height is about fifteen times as great as in the case of the 200 ft. mounting height. Therefore, the oscillation in the former case is much more persistent than in the latter; in fact, the oscillation becomes so persistent for low mounting heights that the power condensers and coupled circuits at present required in spark systems of wireless telegraphy may be dispensed with and a simple series circuit comprising capacity area, tuning inductance and spark gap may be used. Such a circuit has the merit of oscillating at a single frequency, whereas the coupled circuits have two frequencies of oscillation. Passing them to a comparison of the receiving properties to two stations with networks at different elevations, the author shows that if the radius of the network is large as compared with any feasible mounting height, then both stations are ultimately able to abstract energy at the same rate from passing electromagnetic waves, provided these waves are persistent and not rapidly damped. The high antenna is shown to abstract energy at a greater rate than the low antenna during the initial stages (first few swings) of the oscillation. The high antenna will, therefore, respond much more readily to highly damped waves than will the low antenna. This means that when receiving undamped or slightly damped waves the high antenna will be subject to greater interference from atmospheric disturbances than the low antenna. To reduce this interference in the case of stations with high antenna additional capacity is used in the "interference preventer" circuits. In other words, the low antenna is to be regarded as the equivalent of a high antenna and "interference preventer" combined. Finally the bulletin contains the calculated constants of a low antenna whose radiation "figure of merit" equals the estimated figure of merit of the government naval station at Arlington, D. C. The network of the Arlington station is suspended at an elevation of about 500 ft. from three steel towers which contain 1000 tons of steel. These towers are placed at the vertices of an isosceles triangle whose over-all base length is 475 ft. and whose over-all altitude is 488 ft. The low antenna whose constants are given is a circular network having a radius of 540 ft. It thus covers a greater ground area than the Arlington station, but the assumed mounting height for the network is only 33 ft. The advantages of low over high antennæ for high-power stations are as follows: lower first cost (except where the cost of land per acre is very high); no necessity of power condensers; single frequency of oscillation; apparent possibility to obtain a smaller decrement than where power condensers are necessary; less likelihood of damage by lightning; probably less interference from "atmospheric." On the other hand, high antenna have the following advantages over low antennæ: small antenna current (which may be of considerable advantage where arc generators or high-frequency alternators are used); a smaller number of insulators; less likelihood of interruption due to insulator failures.—*Bulletin Univ. of Wisconsin*, No. 810 (Engin. Series, Vol. 8, No. 4).

British Loaded Telephone Cable.—An article on the Birmingham-Sheffield cable which is at present loaded for side-circuit working only, but the electrostatic capacity of the circuits in the cable has been specially balanced to permit of loaded phantom circuits being

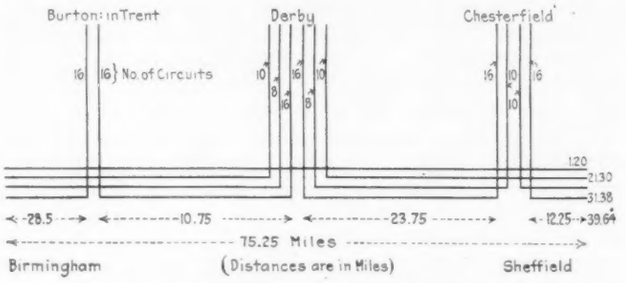


FIG. 4—ARRANGEMENTS OF CABLES AND MILEAGE

obtained when required. This is the longest loaded cable in the United Kingdom in which phantom coils are not yet actually installed and the cable scheme embraces provision for serving three intermediate towns which are situated along the cable route, viz., Burton-on-Trent, Derby and Chesterfield. The allocation of the cable is as shown in Fig. 4, which also gives the cable mileage between the towns in question. The cable and the loading scheme were designed by the engineer-in-chief of the British Post Office. The cable specification provided that the cable should be manufactured, laid and balanced by the contractor in lengths of 2.5 miles (at which points loading coils are inserted). Each 2.5 miles cable length was afterwards tested by the engineers of the post office for capacity and resistance balance, insulation, etc., before the lengths were accepted from the manufacturers. The cable is a lead-covered one of multiple twin formation, and it consists of twenty-seven quads or fifty-four pairs of copper conductors; each wire weighs 70 lb. per mile, and is insulated by paper and air. The final tests consisted of direct-current measurements of the electrical constants of the circuits in the cable, and, in addition, standard cable measurements and cross-talk tests were made. The measured constants of the conductors in the cable gave the following average results:

MEAN RESULTS PER MILE

Weight per Mile per Wire, Pounds	Diameter of Wire		Resistance, Ohms (Loop)	Inductance, Henrys (Loop)	Insulation Megohms Wire to Earth*	Capacity, Farads (Loop)	Attenuation Constant (Calculated)
	In.	Mm.					
70	0.0662	1.681	26	0.053	8440	0.0655×10^{-6}	0.0159

*Between Birmingham and Sheffield.

The standard cable tests gave a result near to the calculated attenuation constant. The terminal loss was equivalent to 5 1/5 miles of standard cable. Cross-talk tests were made in all possible combinations, including side to side, phantom to side, side to phantom, and phantom to phantom circuits.—*Post-Office Elec. Engrs. Journ.*, October, 1916.

Miscellaneous

Pressure Oil Film Lubrication.—H. T. NEWBIGIN.—A long abstract of a paper read before the British Association in which the author reviews the developments of theory and practice of lubrication, with special reference to pressure oil film lubrication and the work in this line done by Osborne Reynolds and by A. G. M. Mitchell.—London *Electrician*, Oct. 6, 1916.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Alfred Schoellkopf of Buffalo, N. Y., has been elected secretary of the Hydraulic Power Company of Niagara Falls, N. Y. The new secretary is a member of the Schoellkopf family which has large interests in Niagara Falls power generating companies and transmission lines.

Arthur C. Cobb, for the past three years new-business manager of the Worcester Suburban Electric Company, Uxbridge, Mass., has been appointed commercial manager of the Commonwealth Electric Company, Summit (N. J.), Lakewood (N. J.) Electric Company, and Point Pleasant (N. J.) Electric Company.

J. O. Montignani, distribution engineer of the Rochester (N. Y.) Railway & Light Company, has been appointed general manager of the Despatch (N. Y.) Heat, Light & Power Company, to succeed Royal Parkinson, recently resigned. Mr. Montignani is a graduate of the University of Edinburgh. In 1914 and 1915 he was chief inspector for the Utilities Mutual Insurance Company.

Edward K. Hall has resigned as vice-president of the New England Telephone & Telegraph Company, and effective Feb. 1 will become vice-president of the Electric Bond & Share Company, with headquarters in New York City. Mr. Hall is widely known in the telephone field, which he entered from the legal side, having been for many years a partner in the firm of Powers & Hall, of Boston, and serving as counsel for the company prior to his election as vice-president. For a number of years Mr. Hall has given personal attention to the public relations of the company and has continuously represented it at legislative and commission hearings, where his discussions of telephone affairs have contributed an unusually interesting and illuminating body of testimony to quasi-judicial proceedings. Mr. Hall was educated at Dartmouth College, and recently declined the presidency of that institution. His legal education was obtained at the Harvard Law School. He was elected vice-president of the New England company in 1912 and resides at Newton, Mass.

E. K. HALL

A. H. Ackerman, vice-president and general manager of the United States Light & Heat Corporation of Niagara Falls, N. Y., has resigned.

Joseph Pratt, in charge of the meter, arc lamp and trouble department of the Blackstone Valley Gas & Electric Company of Worcester, Mass., has been appointed superintendent of the distribution department, to succeed P. F. Hodgkins.

W. J. Gilson, until recently assistant superintendent of the Houghton County Electric Light Company at Houghton, Mich., has accepted the position of superintendent of the Calumet division of the Houghton company, with headquarters in Calumet.

Royal Parkinson of East Rochester, for several years general manager of the Despatch (N. Y.) Heat, Light & Power Company, has resigned to take the position of employment manager of the American Optical Company of Southbridge, Mass.

A. P. Broadhead, formerly superintendent of the Drummondville Division, Southern Canada Power Company, has been transferred to St. Johns, Quebec, as superintendent of the St. Johns Electric Light Company, which is operated by the Southern Canada Power Company.

F. R. Farmer, who has been vice-president and manager of the Beardslee Chandelier Manufacturing Company of Chicago, has resigned that position to take charge of the accessories division of the Gibson Company, an Indianapolis (Ind.) automobile supply house. Mr. Farmer will, however, remain a director of the Beardslee Chandelier Manufacturing Company.

Day Baker, formerly New England manager of the General Vehicle Company, and lately associated with its headquarters sales organization at Long Island City, N. Y., has returned to his former territory and established a new organization to be known as the Day Baker Motor Truck Company, with headquarters at 110 State Street, Boston, Mass. At this address he will become the New England distributor for the Atlantic Electric Vehicle Company of Newark, N. J., and the C. H. Hunt Company, West New Brighton, N. Y., manufacturers of the Hunt electric industrial truck. Shortly before his return to Boston Mr. Baker was made chairman of the electric vehicle committee of the New England section of the National Electric Light Association, as evidence of his welcome back to the New England field, where he has been a pioneer enthusiast and indefatigable worker for the electric vehicle cause.

Chauncey L. Lane, who for several years has been secretary of the United States Light & Heat Corporation of Niagara Falls, N. Y., has been elected vice-president and general manager, to succeed A. H. Ackerman, resigned.

Edwin E. Witte, a member of the faculty of the University of Wisconsin, and an expert in economic and industrial research, has been appointed secretary of the Wisconsin Industrial Commission to succeed Paul J. Watrous, who recently resigned.

L. H. Knapp, for several years in charge of the St. Louis, Mo., substation of the Mississippi River Power Company of Keokuk, Iowa, has accepted a position as commercial agent for the Houghton County Electric Light Company, Houghton, Mich., with headquarters at Houghton.

Edward N. Hurley of Chicago, who was appointed a member of the Federal Trade Commission at the time of the formation of the commission, two years ago, and who for the last year has been the chairman of the commission, has resigned that office in order to resume his business connections in Chicago as presiding officer of the Hurley Machine Company and other corporations in which he is interested.

J. G. Menut has been appointed manager of the Claremont (N. H.) Power Company, succeeding J. D. Whittemore, who recently became associated with the Reading (Pa.) Traction & Light Company. Mr. Menut has been assistant superintendent of the Claremont company since Oct. 1, 1915, and was formerly superintendent of the Colonial Light & Power Company of Springfield, Vt.

C. Nesbit Duffy, vice-president and general manager of the Manila (P. I.) Electric Railroad & Light Company, has been spending a few days in the United States visiting friends and business associates. It is understood that Mr. Duffy will sail for Manila from Vancouver on Jan. 25. Mr. Duffy has been with the Manila company since November, 1913, and has been active in civic improvement work in the Philippines.

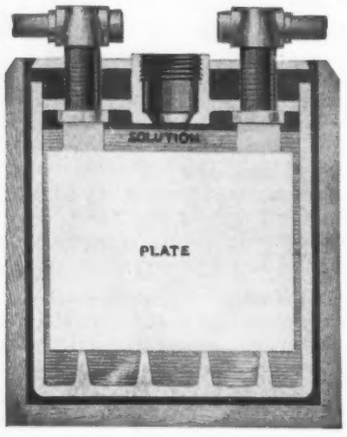
C. N. DUFFY

NEW APPARATUS AND APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Improved Types of Starting Batteries

The Willard Storage Battery Compage, of Cleveland, Ohio, has improved its cell connections for automobile starting batteries. The connection is made wide and flat with the name "Willard" cast in raised letters. It is



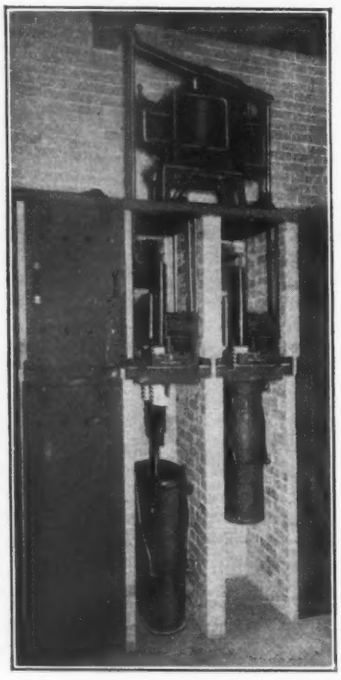
INTERIOR CONSTRUCTION OF BATTERY

pointed out that this connector contains more lead than heretofore used and is consequently more expensive, but has the merit of carrying current with less drop in terminal voltage. Attention is also called to another improvement made by this company in its batteries in which the size of the plates are somewhat different. The accompanying illustration shows the interior construction of the cell.

Oil Circuit Breakers for Cell, Wall and Pipe Mounting

Types E-6 and E-7 oil circuit breakers are part of a complete line recently developed by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., as a modification of the flexibility E-2 and E-4 types of breakers. The new types range in capacities from 300 to 1200 amp. at 23,000 volts, and from 1600 to 2000 amp. at 16,500 volts. The type E-6 is for cell mounting, and the type E-7 for wall or pipe mounting. Operation may be manual, by bell cranks, or electric by solenoids, control in both cases being from the switchboard. All steel construction is used, thus providing breakers exceptionally compact for their rupturing capacity, which ranges from 35,000 to 40,000 kva. at maximum rated voltage with proportionately higher capacities for lower voltages.

These breakers are of the unit pole type, made up by combining single poles mechanically connected for control by single hand lever or electric solenoid, which permits spacing according to local conditions. Attention is called to the fact that for cell mounting, one of the features is a convenient arrangement by which the steel base of each pole unit is held in channel irons built into the cell walls. These units are, therefore, easily slid in and out of these channels, and when in service are tightly clamped in place by set screws. Another new feature that is pointed out in the standard arrangement of electric operating solenoids for cell-mounting breakers, is the mounting of the single pole solenoid complete with its mechanism on a plate and



OIL CIRCUIT BREAKERS

channel frame fastened to the top of the cell structure. In the pipe or wall mounting form of breaker, the pole units are mounted on horizontal pipe supports. Manually operated breakers are full automatic in operation, and the electrically operated breakers can be made full automatic by special arrangement.

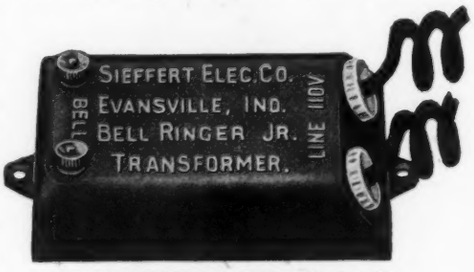
To break the arc as quickly as possible after the breaker starts to open, the types E-6 and E-7 breakers are provided with accelerating springs. An adjustable air cylinder dash pot is furnished to take up the shock of the moving parts at the full open position. The contacts open by gravity, assisted by the accelerating spring referred to above. The moving contacts are of the laminated brush type amply protected from arcing by butt type arcing contacts of increased size. The tanks are elliptical in form, of double lap-welded sheet steel, conveniently arranged for mounting and dismounting.

Tire Inflater Outfit

The Black & Decker Manufacturing Company, 105-115 South Calvert Street, Baltimore, Md., has developed an automatically operated tire inflater tank outfit for automobile air service. This outfit starts working immediately on turning the switch and will keep on until the pressure in the tank reaches 150 lb., then the automatic pressure switch of this inflater outfit comes into action and stops the machine. To inflate a tire, the Romort air chuck on the end of the hose is pressed over the tire valve and the pressure in the tire will rise instantly, it is claimed, to any number of pounds desired. When enough air has been used to cause the pressure in the tank to drop to 120 lb., the automatic switch starts the device again and brings the pressure back to 150 lb. Attention is called to the fact that the device has no exposed mechanism, electrical or mechanical, so that it is impossible for anyone to be injured through coming in contact with moving armatures, gears, rods or shafts. A cover is furnished for the automatic switch which completely encloses all mechanical and electrical parts. These machines can be used on 110 volts direct or alternating current of from 25 to 60 cycles.

Bell Ringing Transformer

The Sieffert Electric Company of Evansville, Ind., has developed the bell ringing transformer shown in the accompanying illustration for use in residences on 110-volt, 60-cycle circuits. The secondary voltage is from 6 to 10



TRANSFORMER FOR RESIDENCE BELL CIRCUITS

volts. It is claimed that this transformer is so efficient that its losses will not register on the average watt-hour meter. The case is of cast-iron, and arranged for easy mounting.

Candle Fixture Socket

Chain pull candle fixture sockets designed to work smoothly in standard fiber or glass candle sleeves, yet of sufficient diameter to fit snugly within the candle have been developed by Pass

CHAIN PULL CANDLE FIXTURE SOCKETS

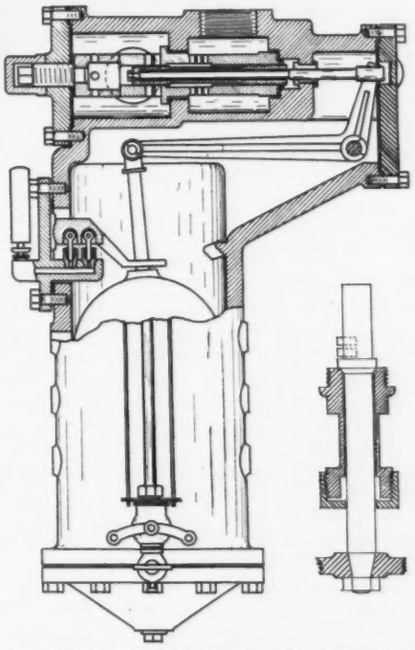
& Seymour, Inc., of Solvay, N. Y. All live parts are concealed within the body with the exception of the terminal plates, so that a short-circuit, from careless wiring, it is claimed, is impossible. The nipple is seated deep in the body of the device and affords a solid connection for the pipe and socket. It is fitted with the standard set screw to prevent turning on the pipe. The chain may be easily removed, making it handy to refinish or to slip through the bobeche, when assembling the fixture. The screws are of large and of sufficient length to accommodate the wires, and the raceways for the wires are deep enough to prevent crowding or bulging of the fiber casing.

Continuous Flow Feed-Water Regulator

The accompanying sketch shows a combined safety water column and a continuous flow feed-water regulator which has been developed by the Ray Manufacturing Company of Louisville, Ky. The principle employed consists of a perfectly balanced valve operated by a float, the feed water being admitted to the valve on its center and discharged on one end. The water passes through the valve in a continuous flow in exact ratio to the evaporation. These regulators are made in 2-in., 2.5-in., 3-in., 3.5-in. and 4-in. sizes, the only difference in construction being in the size of valve and bushing and pipe connections which are made to compare with the capacity needed.

A high and low-alarm whistle is operated by the same float that operates the regulating valve by having two contact points on the float rod engage with the whistle lever. The whistle lever is counterbalanced so that it holds the whistle valve closed when the pressure is off the boiler.

Several mechanical detail improvements that have been made in this regulator are pointed out as follows. The valve bushing, which was originally pressed into the head, is now made loose in head and held in place by a jack screw in the valve chamber head. This construction allows the bushing to be easily removed, it is claimed. The valve bushing now serves the double purpose of a cylinder for the valve to work in and as a strainer to prevent the foreign matter entering the valve. The admission ports are small drilled holes which will not admit any foreign matter that would interfere with the operation of valve. Each regulator is equipped with a testing device so that the high and low-water alarm whistle can be made to blow regardless of the height of water in column or the work that the boiler is doing. This is accomplished by extending the bearing pin for the bell crank to the outside through a stuffing box. This pin has a bar handle and a stop pin on it that works in a slot in the bell crank. In the normal working of the bell crank it will not touch this stop pin but when a test is to be made the bearing pin is turned until it engages the bell crank and the float and valve are made to move their full travel and the whistle to operate. Lugs are cast on the back of the regulator so that the machine can be mounted on a bracket fastened to the front of the boiler and in this way all strain is kept off the piping.



COMBINED SAFETY WATER COLUMN AND CONTINUOUS FLOW FEED-WATER REGULATOR

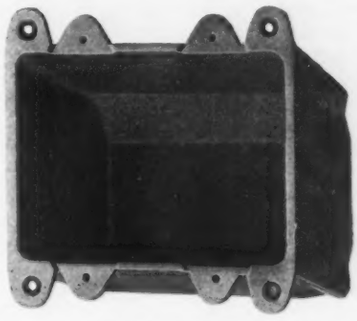
Magnetic Contactor

A single pole direct-current magnetic contactor has been developed and placed on the market by the Industrial Controller Company of Milwaukee, Wis. The same design is also used for double pole contactors. The frame is of heavy cast iron and so constructed as to allow the contactor to operate at an inclination of 30 deg. in either direction. The contact finger tips are of heavy copper forgings, the moving and stationary tips being identical. The design of the contact finger is such that a slight rolling instead of a sliding action is obtained, thus avoiding excessive wear, and at the same time confining the arc to the upper end of the finger tip and maintaining a clean contact surface. The contacts are of liberal proportions and close under heavy pressure, giving ample current capacity and rendering the use of auxiliary brush contacts unnecessary.

The magnet coil is designed for continuous duty without the use of protective resistances. A powerful blow-out magnet is used and the arcing shields can be readily thrown back out of the way when it is necessary to renew the arcing tips. The switch has been designed particularly for heavy duty and is especially suitable for crane and hoist work and steel mill duty.

Cast Iron Switch Box

The Sieffert Electric Company of Evansville, Ind., has developed the cast-iron switch box shown in the accompanying illustration for knob and tube work, and make them in one, two, three and four gangs. These switch boxes are reversible; that is, they can be installed on either side of a stud. They do not need a hanger board or side support across studs for new construction. All that is necessary, it is claimed, is to drive an eight-penny



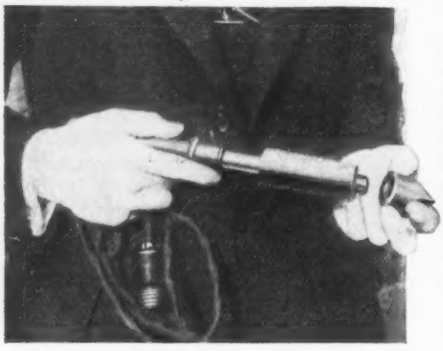
SWITCH BOX MADE IN ONE, TWO, THREE AND FOUR GANGS

nail or to insert a screw in each of the openings and fasten the box directly to the side of the stud. This eliminates fully three-fourths of the work required to secure the boxes in position and insures permanency and rigidity. For old construction these switch boxes are provided with ears for ease of installation.

Electric Soldering Iron

The heating unit of the electric soldering iron shown in the accompanying illustration is hermetically sealed inside the body of the iron. This, it is claimed, prevents moisture, heated solder or flux from penetrating a joint and coming in contact with the heater wire. Steel only is used throughout the structure of the body to eliminate the liability of opening of seams due to unequal expansion. The copper tip is such a design that a threaded core ex-

tends from the body and over this the tip is screwed. The heated core of the body therefore passes directly into the copper tip leading the heat in and concentrating it where it is required. Five standard sizes of this soldering iron are



SOLDERING IRON HEATING UNIT HERMETICALLY SEALED

made by the Cutler-Hammer Manufacturing Company of Milwaukee. The sizes vary in diameter from ⅝ in. to 1.75 in. Besides being used for all soldering purposes, it is claimed that they may be used for melting wax, for branding, etc.

Cycle Counter or Timing Device

A cycle counter or timing device for checking the time elements of high-accuracy relays and of circuit breakers, is shown here as developed by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa. This device indicates definitely the number of cycles required for a relay to close its contacts. The mechanism of this timing device consists essentially of an electric self-winding clock, the escapement of which is operated by an alternating-current oscillating magnet instead of a pendulum or balance wheel.

DEVICE FOR TESTING TIME ELEMENTS OF HIGH-ACCURACY RELAYS AND BREAKERS

At each cycle, one tooth of the escapement is released.

In operation, the cycle counter is connected in series with the relay on a circuit adjusted to give the current value at which it is required to test the relay. When the circuit is closed, the cycle pointer begins to revolve, one step per cycle, and continues to do so until the contacts are closed. The instrument, it is claimed, acts as though it has no inertia; that is, it starts the instant power is applied and stops the instant power is off.

Although primarily designed for use in testing or adjusting time-element relays, this instrument is suitable for a great variety of testing. Its particular field of usefulness is for measuring elapsed intervals of time too short to be satisfactorily observed with a stop watch where readings in steps of one alternation are sufficiently accurate, obviating the use of complicated and expensive apparatus such as chronographs or oscillographs.

Given a known frequency, the readings can be reduced to seconds, if desired. Conversely, by connecting the instrument to a circuit for a definite period of time, the frequency can be determined. By adding contacts to machine tools, elevator machinery, etc., the time required for various functions can be determined. It may also be adapted for use in many laboratories and test rooms for timing purposes.

Electric Garage Pumps

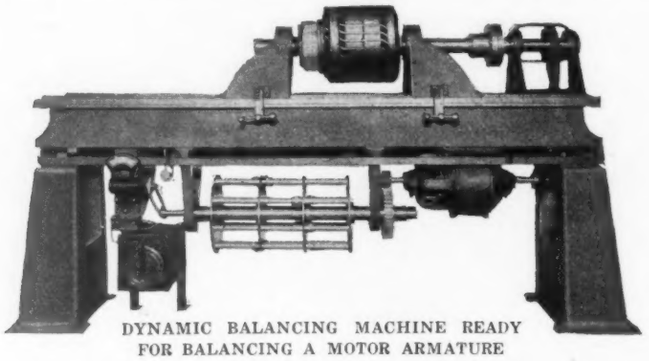
The Hartford Machine Screw Company of Hartford, Conn., has added two new designs to its line of electrically operated garage pumps known as models W and Y. Model W is a two-cylinder pump which may be furnished either on a truck or stationary and is designed for use in the larger public garages where continuous demands are made for tire inflation and quick service must be delivered. It may be used either as a direct pump for supplying air directly into the tires or in connection with a compressed air tank installation in order to maintain a supply of air "on tap." This model is driven by a 0.5 hp. General Electric motor. Attention is called to the fact that in every model of pump no piston rings are used. It is claimed that by eliminating the piston rings and by using extra long pistons, all chance of any oil getting through into the delicate inner tubes of the tire is eliminated. As an added precaution, however, a small expansion chamber is attached to each pump which serves to clarify the air.

The model Y is a stationary belt-driven pump built for garages which are equipped with a power unit and shafting. This eliminates the necessity of an extra motor. In connection with the development of these pumps, this company has adopted the R. S. A. type of electric motor for all alternating current outfits. This type motor, it is claimed, starts and accelerates the load under the low-voltage conditions more easily than the single-phase motor of the straight induction type.

Dynamic Balancing Machine

The machine shown in the accompanying illustration has been perfected by N. W. Akimoff, chief engineer of the Dynamic Balancing Machine Company of Philadelphia, Pa., as a means for determining the amount of unbalance in a rotating machine. This dynamic balancing machine furnishes a means for determining easily and correctly the magnitude and plane of a couple which develops vibrations by the establishment of another couple, which, while maintaining the static balance, counteracts the couple which produces dynamic unbalance. The magnitude and plane of this couple indicates the correction to be applied to the body under test to produce a perfect dynamic balance.

A rigid horizontal beam, such as a lathe bed, is hinged at one end of the machine and supported by a spring at the other. The body to be tested, already in perfect static balance, is rotatively supported on the beam. If dynamically unbalanced, the body will, on rotation, cause the beam to vibrate in a vertical plane. The object of the spring is to amplify the vibrations. A so-called squirrel cage is located on the underside of the beam and, in operation, is rotated in unison with the body being tested. This squirrel cage consists of two circular discs carrying an even number of rods arranged slidably in the two discs and parallel to the axis of rotation of the cages. When the ends of the rods are in one plane, the cage is in both static and dynamic balance, but if two opposite rods are displaced the dynamic balance is destroyed and the couple produced will itself cause vibration of the beam. One pair of rods in the squirrel cage would suffice if the relative position of the rods could be altered through the transmission device, but for convenience, three or four pairs are employed, and even then it is sometimes necessary to change the angular position of the cage so that the balancing can be done by one pair of rods and not two.



DYNAMIC BALANCING MACHINE READY FOR BALANCING A MOTOR ARMATURE

NEWS OF THE INDUSTRY

A Review of Activities in the Electrical Manufacturing, Selling and Central-Station Fields

Public Service Commission News

Iowa Commission

In a case brought against the Sumner Light & Power Company by the Hawkeye Co-operative Telephone Company charging interference from paralleling the telephone line the Railroad Commission held that while there is such an interference it does not justify the abandonment of the transmission line.

The power company received its franchise to use certain highways only after it had agreed with the telephone company to build the lines the same as those between Cresco and Decorah.

On the hearing of the matter, the telephone company which operates a grounded system, contended that the power company "failed in its agreement in that it did not build a three-phase line, did not transpose it, and did not put on a static wire; did not so construct its line as to overcome 'loss of electricity and induction;' did not use the most modern appliances for overcoming induction, and did not use any of the methods now in use for preventing induction, and failed to construct its line in the same manner in which the Cresco-Decorah line was built."

The testimony introduced showed that the transmission line was built on the opposite side of the highway from the telephone, on 25-ft. poles, fifty poles to the mile; 30-ft. poles over all crossings; two No. 6 wires, transposed once every mile; insulators sufficient for a 25,000-volt circuit, but the line only carrying 13,200-volt circuit; the line properly guyed, insulated, and well built. There was no showing that there are any modern appliances or methods in use to prevent induction which were not used in the construction of this transmission line. The showing was that the transmission line was built a single-phase line, not a three-phase line, and that no static, lightning, or overhead wire was used.

In regard to the line being three-phase or single-phase the commission said:

"So far, then, as induction is concerned, it makes no practical difference whether the transmission line is a single-phase or three-phase system. If the transmission line had been built as a three-phase system, it would have had the same effect upon the telephone plant as the single-phase line that was built. This statement is based upon the assumption that each of such lines was equally well built.

"Manifestly, the only interest the telephone company could have in the transmission line being built like the line between Cresco and Decorah, would be for the protection of its telephone line; to avoid interference. If, then, the failure to put on a static wire, and the building of a single-phase system instead of a three-phase line, did not affect the telephone line more than a three-phase line with a static wire would have affected it, it is very clear that the telephone company cannot be heard to complain if such failure in no manner injures it, and the performance of which would in no manner be beneficial to the telephone company. One cannot have redress who has sustained no injury, and where no injury is threatened, unless the performance of the act would have been beneficial.

"Since the hearing of this case, we have had the lines of both the companies involved in this matter examined by an electrical engineer in our employ. From his report, we learn that where the wires of the telephone company enter the houses they are fastened to the wood, and no insulating bushing is used, and that in some places, where examined by him, the wires of its line were resting on wood between the brackets and poles, and were not insulated. The physical condition of the line of the telephone company will probably account, in some considerable measure, for the 'noises.'

"The only testimony on the subject shows that the transmission line was built, in all respects, like the line from Cresco to Decorah, except it is a one-phase line; the same system; no wire was put above, and 'wishbone construction' was not used. Neither of which things have anything to do with induction.

"In nearly all cases, the troubles to a grounded telephone line consequent upon such line being parallel to a transmission line along a highway, may be overcome by making the telephone line a full metallic circuit, and properly transposing the line. The only evidence as to the cost of making the telephone line a full metallic circuit, is, 'it would not cost more than $15 a mile at the most,' and that it would cost the transmission line at least $3,000 to rebuild it as a three-phase line and put on a static wire. From our investigation, and the evidence in this case, such expenditure on the part of the transmission line would be valueless to it and afford no relief to the telephone company. (Since this testimony was taken prices of material have advanced, so that the figures given above should not be accepted.)

"The relief asked by the telephone company partakes very largely of the nature of an application for an injunction. We think a court would not be justified in granting an injunction upon a petition containing such allegations, and supported only by the proofs offered in this case, and in that respect the powers of this commission are no greater than the powers of a court. It being possible, at small cost, to so modify or change the system of the telephone line that both it and the transmission line could use the same highway, without substantial interference with or destruction of the property of either, the transmission line should not be denied the right to the use of the highway. If the telephone company is entitled to recover damages for any interference caused by the transmission line, and for the cost of so changing its plant as to avoid interference caused by the transmission line, such relief cannot be granted by this body, but must be found in the courts.

"We have reached the conclusion that the insulation of the transmission line would be improved if it would use insulators of a higher voltage rating, and we, therefore, order that the Sumner Light & Power Company insulate its line with insulators of a higher voltage rating than is now being used by it.

"We recommend to the Hawkeye Co-operative Telephone Company that it improve its line by placing glass insulators where its wires are now resting on wood between the brackets and poles, and we would suggest that insulating bushing be used where the wires pass through the walls of the houses, and that the trees along its line should be properly trimmed, so as not to interfere with the line."

Barstow Weekly News Letter.—On Jan. 4, W. S. Barstow & Company, Inc., made its initial issue of a weekly news letter designed to disseminate information regarding the company's activities.

Missoula Rates Reduced.—The Missoula (Mont.) Light & Water Company announced on Jan. 1 a reduction in electric rates based on the amount of energy used. Both large and small consumers will be affected.

Improvements to Alaska Radio System.—According to recent reports, the Navy Department will improve the radio system in Alaska in 1917 at an estimated expenditure of $187,277. Among the items included for improving the Alaskan wireless stations are $22,000 for St. Paul, $5,000 for St. George, $8,250 for Kodiak, $7,203 for Sitka, $4,700 for a new station at Seward and $27,500 for a new station at Cordova.

Uniform Rates for Empire Gas & Electric.—The Empire State Gas & Electric Company has adopted a uniform schedule of rates for all of the different communities it serves. In some cases it will increase and in others lower the existing rates. In the aggregate the new rates will increase the gross revenue from the entire territory about 2 per cent. The proposed electric rates follow: Rate No. 1.—A customer charge ranging from $1 to $4 per month, depending on the size of the consumer's connected load, plus 7 cents per kilowatt-hour for all energy consumed. Rate No. 2.—A customer charge of $2.50 per month plus a demand charge of $3 per month per kilowatt connected for six months beginning April 1 each year, and $3.60 per month per kilowatt connected for six months beginning Oct. 1, each year, plus 2½ cents per kilowatt-hour for all energy consumed.

Municipal Utilities Must Be Operated Separately.—According to an opinion handed down recently by R. E. Campbell, Assistant Attorney General of the State of Washington, each municipally owned and operated public utility, including municipal power and light plants, water plants and street railway systems, must be conducted separately and as an entirely distinct business, and special arrangements between various departments of the city as to rates and services cannot be made. Transferring of public funds from one department to another is condemned by Mr. Campbell. In summing up his conclusion, he says: "A city has no power to require one public utility to loan money to another department, unless the current rate of interest is charged. A city has no power or right to require a public utility to furnish free service or service below the usual cost to another utility or municipal department. A city council has no power to appropriate, directly or indirectly, any part of the income or surplus of one utility for the benefit of another utility. The city council has no authority to make a gift of money from the general fund to provide working capital or cover a deficit."

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Municipal Plant Falls Into River.—Supposedly due to quicksand upon which the concrete foundation is believed to have been built, the Lowell, Mich., municipal light plant, valued at $60,000, toppled into the river shortly after midnight two weeks ago. Citizens heard a crash and many rushed to the scene and discovered the plant had fallen into the water and was practically wrecked. It is a question whether the generator or other equipment can be saved. The plant will be rebuilt, it is understood.

Urges Employees to Keep Expenses Down.—In view of the rapidly increasing cost of materials that go into the manufacture of gas and electricity, J. T. Hutchings, general manager of the Rochester Railway and Light Company, has issued a letter to employees explaining that under the circumstances the utmost diligence must be exercised to avoid all waste and cut the cost of production to the irreducible minimum. The letter makes the further point that however much the cost of materials and manufacture may increase under the stimulus of abnormal conditions, the company cannot recoup itself by a corresponding advance in the price of its products. This increase must be absorbed by the company through stoppage of leaks and the highest effectiveness generally on the part of employees. The letter recites a long list of materials showing the price-level before the sharp advance began and the present cost to the company.

A New Insulating Material.—According to the U. S. Commercial Report No. 238 a new insulating material has been developed in Germany which possesses some interesting features. This material is known as "galalith," and is a bone-like substance similar in many respects to celluloid. It is manufactured from casein and formaldehyde. A solution of casein is obtained by treating skimmed milk with caustic alkali, after which the solution is clarified and the casein then precipitated by means of acids and filtered. The water is then extracted under pressure and the product slowly dried over a period extending several weeks. The product obtained is casein plate, which is treated by thorough saturation with formaldehyde and dried again. Galalith is said to be an excellent insulating material somewhat transparent, although never completely so, and of a yellowish-white horn-like color. It is workable either in the hot or cold state, the cold galalith being softened by treatment in hot water. It is odorless, and very much less inflammable than celluloid. It cannot be made into very thin sheets.

Electric Vacuum Cleaner Used to Remove Carbon in Automobile Engine Cylinders.—According to a writer in a recent issue of *Scientific American* the household electric vacuum cleaner has been found an effective means of removing carbon from automobile engine cylinders. The procedure with this method is to treat the engine cylinders with alcohol, kerosene or other agent to loosen the carbon. This is most effectively done by scraping with a suitable tool. The vacuum cleaner is then connected to the cylinder through a tube nozzle and the carbon quickly removed.

Cleveland Illuminating Company Gets Railway Power Contract.—A board of arbitrators has rejected the bid of the Cleveland municipal plant for furnishing energy to the Cleveland Railway Company to take the place of that generated at the Cedar Avenue power station, which is to be abandoned, and approved the bid of the Cleveland Electric Illuminating Company, which was a little less than 6 mills per kilowatt-hour. The arbitrators said the figure presented by the municipal plant might be a little lower in itself, as pertaining only to the energy furnished t replace that of the power house to be abandoned, but that of the Illuminating company not only covered this, but the energy furnished to four substations under a former contract, amounting to about 40 per cent of the total amount used, on which the new figure makes a material reduction. Furthermore, all the additional energy needed during the term of the contract will be furnished at the same figure. The amount of energy needed at present to replace that lost is 30 per cent of the total.

The Illuminating company will be in position to furnish the required energy by July 1, 1917, while the municipal plant could not have installed the necessary equipment for the purpose before July 1, 1918. As estimates show there will be a saving of about $200,000 a year through purchasing energy. This presents another important reason for the award made. The Illuminating company's contract covers a period of eighteen years, while the municipal plant wished to contract for ten years only. The contract with the Illuminating company provides that at the end of five years the railway company may receive bids and, if any competitor proposes to furnish energy at a figure 10 per cent lower than the present rate or so low that the company does not care to meet it, then this contract may be abrogated. The board found that the bid of the municipal plant had not been approved by the board of control, as required by law, and that under it the contract would be tentative, the real basis and details being left for arrangement later on. A. F. Ingersoll, chairman of the board, and Warren Bicknell, the arbitrator selected by the railway company, signed this report, while Thomas L. Sidlo, selected by the city, made an adverse report. The contract was consummated shortly after the report was made to the company and the city.

Adirondack Power Reduces Rates.—On Jan. 1 the Adirondack Electric Power Corporation, Saratoga Springs, N. Y., announced in a circular letter to its customers a reduction in rates for electric energy.

Power Company Employees' Insurance to Be Increased.—The Southern Sierras Power Company and its associated and allied companies have notified their employees that the $1,000 life insurance policy which was given them at the company's expense Christmas, 1915, will be increased to $1,500. This additional insurance will be carried without expense to the employees. The families of about 350 employees are benefited.

Electric Vehicles in Chicago.—The Commonwealth Edison Company has in daily service 145 electrics, of which eight are passenger cars. Another large user is Marshall Field with some 246 electric trucks of various capacities. Altogether there are 780 electric trucks in use in Chicago and some 6500 commercial gasoline vehicles.

Coal Shipments Tightening Up.—Indications are that coal shipments are again tightening up, according to W. S. Barston & Company, due in part to shortage of cars and in part to weather conditions which make the movement of freight slow and uncertain. There is also the possibility of embargoes to which the railroads have resorted frequently during the past year.

Fire Loss Due to Electricity.—After collating and analyzing the details of a very large percentage of all fires in New York, the National Board of Fire Underwriters has ascertained the causes of these fires, for 1915, with the relative losses, to have been as follows: Strictly preventable causes, 21.7 per cent; partly preventable cause, 31.9 per cent, and unknown causes, 46.5 per cent. Electricity is listed under the partly preventable causes and to it was due in 1915 a fire loss of $935,413 in New York, or 4.7 per cent of the total loss in the state that year from fire. For the same year electricity was the cause of 3.9 per cent of the fire loss of New Jersey and 6.0 per cent of that of Pennsylvania.

Convention in February.—The New Mexico Electrical Association will hold its annual convention in Albuquerque, with headquarters at the Alvarado Hotel, Feb. 12, 13 and 14.

New Hampshire Contractors Organizing.—Steps towards the organization of a New Hampshire Electrical Contractors' Association were taken on Jan. 5 at Concord.

Jobbers' Association Meetings.—The next semi-annual meeting of the Electric Supply Jobbers Association will be held at the Homestead Hotel, Hot Springs, Va., May 22, 23 and 24. The quarterly meeting of the Pacific division was held at Del Monte, Cal., on Jan. 11, 12 and 13.

New Chicago Club Officers. — The new officers of the Electric Club-Jovian League of Chicago, are: President, H. A. Mott; first vice-president, B. E. Blanchard; second vice-president, George H. Jones; secretary-treasurer, W. H. Hodge, and trustee, H. A. Porter.

Mid-Winter Meeting of Illinois Electrical Contractors.—The Electrical Contractors' Association of the State of Illinois will hold its mid-winter meeting at the Hotel Sherman, Chicago, Jan. 25 and 26. Louis B. Van Nuys of the Central Electric Company of Peoria, Ill., is secretary-treasurer of the association.

The Electrical Development and Jovian League of San Francisco.—The regular luncheon of the Electrical Development and Jovian League held on Jan. 3 was arranged as a farewell to F. H. Leggett, Pacific Coast manager of the Western Electric Company, who has been transferred to the New York office of the company.

Philadelphia Iron and Steel Engineers to Discuss Polyphase Motors.—At the February meeting of the Philadelphia section of the Association of Iron and Steel Electrical Engineers James Burke, president of the Burke Electric Company, Erie, Pa., will present a paper entitled "Polyphase Motors." Will J. Davis, Jr., president of the American Lighting Company, Chicago, Ill., addressed the section on Jan. 6 on the subject, "Industrial Flood Lighting, Its Origin and Application."

Associations and Societies

A complete Directory of Electrical Associations is regularly printed in the first issue of each month on the next-to-last text page.

Cleveland League Hears About Mexican Power Development.—At the Jan. 11 meeting of the Electrical League of Cleveland, H. M. Morrison, electrical consulting engineer, spoke on the following subject: "The Development of Water Power in Mexico for Generating Electricity; also a Short Description of the Tehuantepec National Railroad Company as a Competitor of the Panama Canal."

Indiana Engineering Society to Meet at Purdue University.—The features of electrical interest on the program for the 1917 meeting of the Indiana Engineering Society, which will be held at the electrical building, Purdue University, LaFayette, Ind., Jan. 18, 19 and 20, are as follows: Address of welcome, Prof. W. E. Stone, president Purdue University; address of president, Prof. L. W. Wallace; address by Gen. Anson Mills, Washington, D. C.; "Financial and Ethical Status of the Engineer," by Prof. F. C. Newell, Urbana, Ill.; "Electrical Lighting," by Prof. A. M. Topping, LaFayette, Ind.; "Street Lighting in Small Towns," by Samuel B. Mott, Noblesville; report of committee on electrical engineering and electrical railways; "Human Engineering," by E. B. Smith, Marion, Ind.; "Cases Before the Public Service Commission During the Past Year," by H. O. Garman, Indianapolis; "Cost to the Utilities of Rate Investigation," by Charles E. Hurd, Indianapolis; "Public Utility Lines," by Peter Junkersfeld, Chicago; "Cost Accounting," by Harrington Emerson; report of committee on power plants, and election of officers. Charles Brossmann, 1616 Merchants Bank Building, Indianapolis, Ind., secretary of the association, has also announced that the annual banquet will be held at 7.30 p. m., Jan. 19.

Western Association of Electrical Inspectors to Meet at Toledo.—William S. Boyd, secretary of the Western Association of Electrical Inspectors, has announced the following program for the twelfth annual meeting of that association, which will be held at the Hotel Secor, Toledo, Ohio, Jan. 23, 24 and 25: Address of Welcome, Hon. Charles M. Milroy, Mayor of Toledo; Reply to Address of Welcome, Emil Anderson, Minneapolis; Address of President F. H. Moore; reports of other officers and committees; "Industry Conference Standards," by A. R. Small, Chicago; "Lamp Socket Rating," by Dana Pierce, New York; "The Fire Hazard in Organ Wiring," by Washington Devereux, Philadelphia; "The Squirrel-Cage Type Induction Motor and Its Wiring," by G. S. Lawler, Boston, Mass.; "The Electrical Manufacturer's Point of View," by F. A. Barron, Schenectady, N. Y.; "The Electrical Contractor's Point of View," by H. R. Fowler, Toledo, Ohio; "The Electrical Engineer's Point of View," by W. E. Richards, Toledo; "The Central Station's Point of View," by W. E. Richards, Toledo; "The Electrical Inspector's Point of View," by Ralph E. Knox, Louisville, Ky.; "Advantages and Disadvantages of the Insulated Inlet Bushing for Sockets and Outlet Box Covers," by F. D. Varnam, St. Paul, Minn., and Dana Pierce, New York; three points of view on "The Relation of Feeder Sizes to Connected Load," by Oscar M. Frykman, Minneapolis, Minn., G. Southern, Toledo, Ohio, J. J. Duck, Toledo, Ohio, and H. B. Gear, Chicago; "The Field Trial of the National Electrical Safety Code," by Dr. E. B. Rosa, Washington, D. C.; "Insulated Service Conduit and Cabled Service Wires," by George E. Bruen, New York; four points of view on "Shall the Insulating Joint Be Abandoned in Connection with Electric Light Fixtures," by Joseph C. Forsyth, New York; a representative of the Macallen Company; Howard R. Sargent, Schenectady, and W. J. Canada, Washington, D. C.; "Electrical Development," by Henry L. Doherty; open discussion of inspectors' problems, and election of officers. The convention will be closed Thursday, Jan. 25, by a banquet. Inspection tours about the city have been arranged for Jan. 26.

REVIEW OF TRADE AND MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

ELECTRIC RANGE BUYING IN 1917

Twenty-Three Central Stations Report the Probable Sale of 14,325 Ranges

Unless something unforeseen happens the coming twelve months should result in a much wider sale of electric ranges than in any previous year. In reply to letters sent out by the Electrical World to some of the central stations that are playing an important part in the distribution of ranges asking for figures on the number of ranges they proposed to sell in 1917 the following data were received: New England States, ten companies, 2255 ranges; Atlantic States, two companies, 200 ranges; Central States, seven companies, 5790 ranges; Pacific and Mountain States, nine companies, 6280 ranges, a total of 14,325 ranges to be sold by a total of twenty-three companies. Inasmuch as the average sale price of electric ranges is around $100 the sales of just the above ranges would be, roughly, $1,500,000.

Replies were received from other companies, saying that the sale of ranges would be actively taken up in 1917, but no figures as to the probable sales were given. The replies also disclosed that orders had been placed already for at least 25 per cent of the 14,000 ranges.

There seem to be a number of factors which will militate against electric range sales this year. The old feeling of the central stations that the price was too high was intensified by the fall increase in prices. Since the replies were written another increase in price of ranges has been announced.

While there seems to be little doubt that the central stations are, and must so remain during the initial years, the logical distributers of electric ranges the central station discount is less than that of the jobber. This some central stations feel, and particularly those in the far West, where the greatest development of electric cooking is taking place, is not right.

KENNY PATENT UPHELD

Circuit Court of Appeals Renders Decision on Basic Vacuum Cleaner Patent

The United States Circuit Court of Appeals has affirmed the decree of the District Court for the Southern District of New York, adjudging valid the fourth claim of letters patent No. 847,947, the Kenny patent, and granting a permanent injunction against infringement and an accounting of profits and damages subsequent to October, 1915. The patent is the basic vacuum cleaner patent. The suit was brought by the owners of the patent, the Vacuum Cleaner Company against the Innovation Electric Company, Inc.

Claims 1, 3 and 4 were previously declared valid by Judge Mayer in the case brought against the American Rotary Valve Company. Article 4 which was under contention in the case just settled has to deal particularly with two features, namely, that the cleaner shall have a suction chamber and that the cleaning tool shall have a narrow slot.

In its decision the court says in conclusion:

"Kenny, with little or no capital, invented a cleaner which has met with great success by reason of the novelty and intrinsic merits of the device. The hand implement under consideration is one of the forms of the Kenny invention. We think Kenny's contribution to the art of vacuum cleaning has been sufficiently fundamental to entitle his patent to a broad interpretation and when given such interpretation there can be no doubt that the defendant's devices infringe."

Under the licensing arrangements only a certain number of licenses are permitted and in order to acquire a license the purchaser must at the same time buy the entire vacuum cleaner business of the seller. Licensees, however, may make machines under any trade name for different distribution and such machines may bear the Kenny patent trademark. Some of the machines marketed by the Innovation company are manufactured under a license and arrangements have been made to so manufacture the other types.

There are a number of electric vacuum cleaner manufacturers whose cleaners are not licensed. Whether they will accept the result of this decision is not known. It has been rumored, however, that further litigation may be expected on the electric portable cleaners.

FAN SEASON OPENING UP

Few New Models Developed—Number of 1917 Models Have Steel Instead of Brass Guards

Within a few weeks the 1917 electric fan campaign to the trade will be fully launched. A number of the manufacturers are now ready and some have already begun. There are some, however, that still have loose ends to tie together. Literature has been prepared, stock laid in and the desired changes made in design. The only real factor that remains undetermined in a number of cases is that of price. It is certain that prices will be higher in 1917, but how much has as yet not been determined. Some fans have advanced but a few per cent in price, while others have gone up as much as 30 per cent over 1916 prices.

Of one thing the manufacturers are certain and that is a market thoroughly depleted of fan stocks. Last summer developed real fan weather, especially in the Middle West. Practically every jobber is sold out. This is an entire reversal of the conditions found at the beginning of 1916, when, owing to the unseasonableness of the 1915 summer, a very large stock of fans was carried over. It is, therefore, expected, from the manufacturers' standpoint, that 1917 will be an excellent fan year.

Few new fans will be placed on the market this year. There are some changes in design which for the most part are of a minor character. One of the changes that is rather general is the replacement of the brass guard with one of steel. An authority estimated that fully 90 per cent of the 1917 fan production will have this change included in it. Some well-known lines will still appear entirely in brass.

In the fan blades there is no tendency toward a general change for 1917. It is true that a few companies are planning to put out some steel and even some wooden-bladed products, but the number of these fans offered this year will be small when compared to the year's total production.

There are several causes for the change in guards:

First, the 1916 fan season produced an exceptional volume of sales, practically clearing all of the stocks in the hands of jobbers and dealers, and exhausting manufacturers' stocks and unassembled parts. The year 1917 is, therefore, an appropriate time to effect a change in outward appearance of the products.

Second, the change will improve the appearance of the fans. As one manufacturer aptly phrased it, "There are probably other determining factors as important as the state of the brass market and the state of the fan trade. The tendency to take note of the location in which fans are used and to make them harmonize more readily with surroundings is an important factor in the elimination of glittering brass generally. It is probable that the predominance of fans finished in color instead of in any metal finish will be noticeable during the coming season."

Furthermore, it has been pointed out that the black guards will not show fly specks much and will be very easy to keep clean.

Although the price of brass has advanced it is not the ruling factor, because, between the price of fabricated steel guards and blades and fabricated brass guards and blades, there is not a wide margin of difference. This is due to the present high price of steel and the greater cost of working steel. Nevertheless, it is rather generally felt that the change from brass to steel will be permanent and that in the future when raw material prices are readjusted, the wisdom of the present change will be more apparent.

It is not expected that this change, which has been largely forced on the fan manufacturers, will cause any loss to the trade or to the public. The opinion is firmly held by those making the change that the steel guards which have been developed are more attractive in appearance, are stronger and more durable and will be in better condition as regards finish after a year's service than brass guards would be.

COPPER QUOTATIONS LOWER

With Spot Prices Now Down to Purchase Price No Further Drop of Importance Is Expected

Copper is dropping in price from the high levels registered a month ago. It is still, however, more than double peace values. Spot copper was quoted on Tuesday at 28 cents with February metal 0.5 cent lower. First quarter copper was quoted at 27.5 cents, second quarter at 26.5 cents, third quarter at 25.5 cents and last quarter at 24.5 cents. These are all nominal prices.

Producers are sold out for the first half of the year and any copper they might offer is on account of a customer who has copper for resale. There is a feeling that until the second half of the year copper will stay at practically the present quotation. The market is now at about the same level it was when the copper for first half delivery was purchased. There being, therefore, little or no opportunity to make a profit in resale, it becomes apparent that less copper will find its way to the market. Any further offering would only tend to depress the market still more.

Quotations on copper wire base on Tuesday were 34.25 cents spot and 34 cents, February delivery.

PLACE OF UNITED STATES IN JAPANESE FOREIGN TRADE

Official Statistics for 1914 and 1915 Show but Small Amounts of American Products Purchased by Japan

Official statistics of the foreign commerce of Japan in electrical and allied goods during 1914 and 1915 have recently been issued showing the electrical goods imported from different countries. Of a total of $6,132,500 of electrical and allied goods imported to Japan in 1914 but $1,805,500 were of American origin. In 1915 the total imports were $4,495,500, of which $1,908,500 were made in the United States.

Germany led before the war in electrical goods sent to Japan. In 1914 the German total was $2,156,500 and England was second with $1,589,000. The United States was third. In the following year but $119,000 were German made, while the imports from Great Britain were $1,157,500. Imports of American made goods, therefore, exceeded those from any other country in 1915.

However, most of this trade was in goods allied to the electrical trade, such as galvanized iron wire, turbines, cranes, poles, internal combustion engines, boilers, crude insulation, etc. Of straight electrical products the total imports in 1914 were but $2,031,500 and in 1915 they were $503,500. Of the 1914 imports $682,000 were manufactured in the United States and in the next year $257,000.

Prior to the war Germany ranked first in the Japanese market in galvanized iron wire, transmission line materials and poles, insulated electric wire, steam turbines, pumps, internal combustion engines, water turbines and wheels, incandescent lamps and wattmeters. England ranked first in copper tubes and pipes, cranes, steam engines, steam boilers and storage batteries. The United States stood first in dynamo electric machinery, and ammeters and voltmeters.

NEW YEAR BRINGS ADVANCE IN APPLIANCE PRICES

Raw Materials Purchased at Top of the Market Have Greatly Increased the Cost of Manufacture

As was predicted some weeks ago in these pages, the New Year has brought higher prices for electric appliances. With but few exceptions the price is now higher or will be higher in a few weeks on fans, toasters, flatirons, ranges, vacuum cleaners and washing machines. The advance on the heating appliances is scheduled for Feb. 1 and will be a minimum increase over the Oct. 15 schedule of 50 cents on flatirons and toasters and $5 on ranges.

Fan prices have advanced from a few per cent in some cases to 30 per cent in others, depending largely on the design of the apparatus. Washing machines have advanced on the average of 10 per cent over last year's prices. The advances in vacuum cleaner prices generally have been 10 per cent or more.

These prices have been caused almost entirely by the high prices for raw materials that obtained last year when stocks were ordered. In a number of cases the cost of manufacture of goods for 1917 sale has been greater than the 1916 prices.

There is, however, hesitation, particularly on the part of fan manufacturers, to name a 1917 selling price. In 1916 the price, it is pretty generally admitted, was too low. There is no intention of making this mistake again. On the other hand, the manufacturers are equally anxious not to increase the price unnecessarily.

In some quarters it is freely admitted that at these prices the gross volume of sales will be less, but it is felt that it is the better policy to do a smaller business at a safer margin of profit than to accept larger orders at a margin of profit too small to be safe. Where the decrease will probably come will be in selling a cheaper article where formerly a more expensive one was sold. This undoubtedly will be largely the fault of the merchandising agent. The central station buyer, or the contractor, or the dealer, and even the jobber, knowing the former prices appreciate the extent of the advance. It is, however, rather generally forgotten that the general public knows little or nothing about prices and that the higher prices do not mean nearly as much to the public as to the man who is constantly dealing with them. In other words, the public buys what the merchandising agents' buyer decides the public is going to buy. An instance of the mistake that is thus made is recalled. A large central station company with many branch offices formerly sold large numbers of a well-known make of toaster that production costs have forced to the price of around $7. The same manufacturer brought out last fall a cheaper toaster to sell at the same price that the $7 used to sell at—some $3 less. This central station stocked up on the $4 toasters and would not lay in a single $7 toaster. During the holiday trade this company had a large number of inquiries for the higher priced toaster and the customers seemed disappointed when told that the best that could be offered was the $4 article. Furthermore, there is little doubt but that a large percentage of those who purchased $4 toasters would have just as willingly ordered a $7 article had it been shown. There are many just such cases where the merchandising agent has allowed his own fears to dictate what shall be sold rather than the demand of his customers.

In the case of ranges there was a real opposition by the central station to the former prices, but with the fall advance and the advance to come shortly this opposition will probably become stronger.

By properly selling the merchandising agent, however, the manufacturer should be able to prevent such occurrences as above related. There is a real demand for electrical appliances and what the customer wants is something that will do what is claimed for it. Electric appliances are not such commodities that the public know the prices, and even if the old prices were rather generally known, the public appreciates that everything has gone up in price. For these reasons it is argued in the wholesale trade that the one to be sold is the merchandising agent—after that the retail trade will take care of itself.

Manufacturing and Industrial

Moulton Engineering Corporation announces the opening of a New York office at 233 Broadway, under the direction of Horace W. Flashman.

Babcock & Wilcox Company, manufacturers of watertube boilers, will build an addition to its plant at Lexington Avenue and Third Street, Bayonne, N. J., to cost about $100,000.

Driver-Harris Wire Company announces the appointment of George A. Lennox as western district sales manager, succeeding Stanley M. Tracy, who will in the future operate from the main office as assistant general sales manager.

Century Electric Company, St. Louis, Mo., announces the establishment at 10 High Street, Boston, Mass., of a branch office under the direct control of the home office for the handling of all sales matters in the New England States.

The Westinghouse Lamp Company has purchased a tract of 5 acres of land on Pennington Avenue and the Philadelphia & Reading Railroad, Trenton, N. J., for the erection of a new manufacturing plant. The initial capacity will employ about 500 persons.

F. R. Blair & Company, Inc., 50 Church Street, New York City, announces that on Jan. 1 H. H. Gildner, who has been for the last three years chief engineer of the S. K. F. Ball Bearing Company, Hartford, Conn., joined the Blair organization as manager of the "Flexite" department. Mr. Gildner will make his headquarters in New York.

H. W. Johns-Manville Company has opened a new office at 911 Walnut Street, Des Moines, Iowa, Jan. 1, bringing the total number of branches up to fifty-five. Practically every important city in North America now has a Johns-Manville branch. Wm. B. Roberts, who has been with this organization for a number of years, caring for the Iowa sales, has been appointed manager of the new office.

Samuel G. Hibben, formerly head of the engineering department of the Macbeth-Evans Glass Company of Pittsburgh, Pa., and associated with the Westinghouse Electric & Manufacturing Company, has recently become identified with the Westinghouse Lamp Company. Mr. Hibben is well known as chairman of the Pittsburgh section of the Illuminating Engineering Society. With the lamp company he will continue in the engineering work, furnishing expert lighting advice to the various users of Westinghouse Mazda lamps. Mr. Hibben will have his headquarters at the Pittsburgh office.

Western Electric Buffalo Staff Celebrate.—Members of the Buffalo, N. Y., staff of the Western Electric Company celebrated the increased business handled throughout western New York during the past year at a banquet and sales conference held at the Iroquois Hotel. New specialties for 1917 were announced by J. W. Tabb, manager of the Buffalo branch, and plans for the sales work were considered. Many suggestions were made by various members of the staff and the spirit of co-operation was reflected in all the discussions. In the evening a banquet was held at the hotel for members of the sales staff and employees of all departments.

New Exide Service Station in New York—The increase in the use of "Exide" batteries for automobile service in and around New York City has made it again necessary for the Exide Battery Depots, Inc., to increase its service facilities with a new service station and electric vehicle garage at Sixty-fourth Street and West End Avenue. This new location will be the official "Exide" headquarters in New York City. The company will retain its West Side commercial electric vehicle garage at 527-541 West Twenty-third Street, as well as its East Side garage at 141-155 East Twenty-fifth Street, giving the company three separate and well-situated locations in New York.

The Thomson Spot Welder Company, 84 State Street, Boston, Mass., which was recently incorporated, has a plant at Cincinnati, Ohio, and will manufacture electric spot welders, having acquired the Harmatta patent of spot welding, it is said, and other spot welding patents of the Thomson Electric Welding Company and the Universal Electric Welding Company. The Thomson Spot Welder Company is owned by the Thomson Electric Welding Company of Lynn, Mass. The officers are J. W. Farley, president, and George A. Cutter, treasurer. Mr. Farley is also president of the Thomson Electric Welding Company, and Mr. Cutter is general manager of the Thomson Electric Welding Company.

The Frantz-Premier Company, Cleveland, Ohio, manufacturer of electric vacuum cleaners, has just increased its capital stock to $1,500,000, made necessary by the need for larger manufacturing facilities to handle the large growth of business during the year just closed, when the Frantz-Premier Company's business was about twice that of 1915. The company employs 500 men and turns out 500 electrical units per day. Practically all parts, including castings and motors, are made in the company's own factory. Within a short time, according to an announcement by an official of the company, other electrical labor-saving household devices will be added to the Frantz-Premier lines.

Better Conditions Expected in the Reflector Trade.—The National X-Ray Reflector Company of Chicago, and other companies which use cyanide in some of their plating processes, have suffered as the result of the power shortage at Niagara Falls. All of the cyanide made in this country is manufactured by one company, which has plants at Niagara Falls, and Perth Amboy, N. J., and the output of this concern was greatly reduced when the Canadian government requisitioned electrical energy it had been exporting to the United States. The records of the X-Ray company also show that labor in the trade during 1916 was transient. Of the number of factory men hired during 1916 only 18.7 per cent remained in the employ of the company. In spite of these difficulties the company's production department was able during 1916 to fill orders, so that the volume of 1916 business exceeded that of 1915 by 33 1/3 per cent. Better conditions on delivery and another 33 1/3 per cent increase are expected during the current year.

Co-operation in Promotion of Argentine Trade.—At a recent meeting in New York the organization of the Argentine Mercantile Corporation with a capital of $5,000,000, for marketing American goods in Argentina, was perfected by a number of the leading manufacturers of the country. The feature of the organization is that no competing lines of goods will be carried and that each manufacturer will bear a share of the expense of marketing his product in Argentina in proportion to the extent of his business. The corporation combines in one solid organization the distributing, selling and financing of the merchandise of the manufacturers. It has taken for its salesrooms in the city of Buenos Aires an entire building in the center of the retail district. Purchasing and forwarding offices are to be maintained in New York City. The building in Buenos Aires which is now being fitted up for the corporation, and will probably be occupied by next March, is being outfitted for the display of the samples of the allied manufacturers. Each classification of trade will be exhibited in a separate department, and each department will be in charge of an experienced manager, with a competent corps of salesmen and travelers experienced in the merchandise trade and customs of the Argentine.

NEW YORK METAL MARKET PRICES

	Jan. 3 — Selling Prices Bid	Jan. 3 — Selling Prices Asked	Jan. 9 — Selling Prices Bid	Jan. 9 — Selling Prices Asked
Copper	£ s d		£ s d	
London, standard spot	133 10 0		133 0 0	
Prime Lake	29.00	to 29.50†	28.25	to 28.75†
Electrolytic	28.00	to 29.00†	27.75	to 28.25†
Casting	27.00	to 28.00†	27.00	to 27.50†
Copper wire base	36.00†		34.25†	
Lead	7.50		7.50	
Nickel	50.00		50.00	
Sheet zinc, f.o.b. smelter	21.00		21.00	
Spelter, spot	9.67½	to 9.92½	9.42½	to 9.67½
Tin, straits	42.75†		42.60†	
Aluminum, 98 to 99 per cent	55.00	to 58.00†	54.00	to 57.00†

OLD METALS

Heavy copper and wire	24.00	to 25.00†	23.00	to 23.50†
Brass, heavy	14.12	to 15.50†	14.50	to 15.50†
Brass, light	10.50	to 11.00†	11.00	to 11.50†
Lead, heavy	6.50	to 6.62½†	6.50	to 6.62½†
Zinc, scrap	6.00	to 6.25†	6.00	to 6.50†

COPPER EXPORTS

Total tons to Jan. 9 6162

†Nominal.

BOSTON EDISON COMPANY BORROWS MONEY CHEAPLY

President Edgar Discusses Its Financial Affairs Before the Massachusetts Commission and Says the Company Has the Best Credit in the City Because It Has No Permanent Debt

At a hearing Dec. 29 before the Massachusetts Gas and Electric Light Commission upon a petition for stock increase, President C. L. Edgar, of the Edison Electric Illuminating Company of Boston, discussed the financial policies of his organization at considerable length. Mr. Edgar pointed out that the more money the company can borrow temporarily the cheaper its financial administration becomes. The company has paid as low as 3 per cent. and as high as 6 per cent. for money in the past three or four years. At the moment it looks as though money would be considerably higher in 1917 than in 1916. Money is to-day 4.5 per cent. "The Boston company," Mr. Edgar stated, "has prided itself on having the best credit in town. I think we can borrow money as cheaply as anybody on the street, entirely due to the fact, as bankers tell us, that there is no permanent debt. We have $22,000,000 par value of capital and $15,000,000 of premium, but we would have to consider the par value of the capital in striking a proportion to put out in a bond issue rather than capital and premium. Our conditions are rather different from those in other states and in different kinds of corporations. I think it is perfectly true that we can afford to have $5,000,000, possibly $10,000,000 of bonds out. I don't think it would save us much money, however.

"For instance, we could put out nothing less than a 5 per cent. bond. Some bankers have told me within a month that they didn't think we could put out a 5 per cent. bond at par. We are paying 12 per cent., but we are paying it on a price of $215 and not $180. The very theory of the Massachusetts law is that the people who bought their stock in the earlier days have had it automatically watered by the state, and when we put out our stock under your order at $215 we have to pay a dividend and a proper dividend on the $215. (The commission here disclaimed responsibility for dividends.) Of course, the men who got the stock at $100, $125 and $175 are getting a larger return than the people who got it at $215. As you know, we have tried seriously to have that law changed and have not succeeded and we thoroughly believe that the law is bad."

Mr. Edgar pointed out that the relation between the market price and the dividend is very uncertain. The company's stock sold up to $300 when it was paying 10 per cent., but that did not mean that it was worth it. It is in the management's interest to have the stock put out at the highest price that it believes it will bring. The setting of the price is purely a matter of judgment between the directors and one or two bankers who are consulted. The value of what the stock represents cannot be taken into consideration. If the stock is issued at too high a figure to be taken, it becomes a reflection on the judgment of the management. Market conditions have been very erratic during the last six months and may be worse.

"If we had any material amount of bonds," said Mr. Edgar, "I feel very sure that our financial condition would not be as good as it is to-day. I am perfectly willing to admit, on the other hand, that the time may come, and come soon, when we may have to issue bonds." The witness said that the time is coming when Boston will not absorb all the stock the company will need. The company has no sale for its stock at present outside Massachusetts. "We could no more sell stock in London, as some of the big companies have done, than we could fly," said Mr. Edgar, "because we haven't given the kind of security that the rest of the world has given."

Mr. Edgar said that there is no question about the ability of the company to sell bonds. The first bond step is a difficult one because it starts a policy which inherently leads to a company's being a bond rather than a stock company. Commissioner Schaff stated that the long-established policy of the British Empire, including Canada, requires that from 25 to 33 1/3 per cent. of all additional capital shall go out as bonds, low interest bearing liabilities. "That has been tried for nearly fifty years," said the commissioner, "and there has not been a wreck in all the history of England, Scotland and Ireland of all their company plants." Mr. Edgar maintained that it does not follow that the customers profited by the English and Canadian policy. Although it may be a good point that a reasonable amount of bonds does not weaken the credit of those companies, it does not at all follow that the Canadian companies could not sell energy at a lower price if they financed themselves in some other way. Not over 200 to 300 shares of Boston Edison stock are sold on the average each week.

Corporate and Financial

Commonwealth Edison Company, Chicago, Ill.—A 10 per cent increase in the capital stock of the company has been voted by the stockholders and the directors of the company and has been authorized by the State Public Utilities Commission of Illinois. The amount of the increase is $4,583,900. This will bring the company's total authorized issue of capital stock to $50,000,000. The stock is now being offered to stockholders of record Jan. 10, 1917, and is to be paid for in four installments, Feb. 1, May 1, Aug. 1 and Nov. 1. The money is to be used for general extension of the company's business.

Georgia Railway & Power Company, Atlanta, Ga.—The accrued and unpaid dividend of 24 per cent on the $2,000,000 first preferred cumulative 6 per cent stock has been declared payable Jan. 15 to holders of record Jan. 5 as follows: 3 per cent in cash and the remaining 21 per cent in non-interest bearing script maturing at the rate of $30,000 each six months, beginning July 1 next and ending Jan. 1, 1924. This is subject to the approval of the Georgia Railroad Commission. The commission has also been asked to authorize the issuance of $459,000 of 5 per cent first and refunding mortgage bonds of 1914 on account of improvements and additions and lands acquired, and also $283,000 of Georgia Railway & Electric Company refunding and improvement mortgage 5 per cent bonds of 1907 on account of capital outlays. It is understood that the company has acquired the properties of the Franklin Light & Power Company, Broad River Power Company and the J. B. McCrary Company at Hartwell, Ga.

Northern Idaho and Montana Power Company.—After an examination of the property a plan of reorganization has been formulated for the purpose (1) of preserving the property of the company, (2) of reducing the fixed charges to an amount safely within the net earning capacity of the reorganized property, and (3) of providing adequate capital for present and future requirements. Consideration has been given to the holders of the floating debt and of the preferred and common stock; $2,426,550 par value of common stock will be given to the holders of the floating debt with the arrangement, however, that they shall offer this stock to the preferred and common stockholders at $15 per share. Particular attention is called to the fact that $1,742,500 par value of bonds of the company, owned by the Standard Gas and Electric Company, H. M. Byllesby & Company and William P. Bonbright & Company, Inc., will be subordinated to the other bonds of the company, and under the plan, if carried out, will receive for these bonds only $87,125 in new bonds and the remainder in new preferred and common stock. Should the plan not be carried out, the bonds owned by these companies will, of course, share the same as other bonds of the company. Should any other holder of bonds desire to do so, he may, by electing at time of deposit, exchange his bonds on the basis of the exchange of the Standard Gas & Electric Company, H. M. Byllesby & Company and William P. Bonbright & Company, Inc., up to the amount of the securities available for that purpose, the election of bondholders to be accepted in the order received until the amount of securities is exhausted. The holders of bonds, preferred and common stock desiring to participate in the reorganization must deposit their securities on or before April 1. The provisions of the plan will result in these new securities: bonds, $3,000,000; preferred stock, $1,794,150; common stock, $5,000,000.

New Utility and Industrial Companies

The Canyon Light & Power Company of Wallace, Idaho, has been incorporated with a capital stock of $100,000.

The Pomeroy (Pa.) Utility Company has been incorporated with a capital stock of $1,000 by H. P. Collins and others.

The Philip (S. D.) Light & Power Company has been chartered with a capital stock of $10,000 by O. K. Whitney and others.

The Wood River Power Company of Hailey, Idaho, has been chartered with a capital stock of $27,500 by I. E. Rockwell, L. R. W. Rockwell and E. W. Rising.

The Farmers Light & Power Company of Kalona, Iowa, has been chartered with a capital stock of $10,000. Joseph C. Brenneman is president and C. C. Yoder is secretary.

The South Bay Power Company of Toronto, Ontario, Canada, has been incorporated with a capital stock of $1,000,000 by Alexander Fasken, James Aitchison, 36 Toronto Street, Toronto, and others.

The Del-Home Light Company of St. Louis, Mo., has been incorporated with a capital stock of $15,000 to manufacture electric-light fixtures, etc. The incorporators are: W. O. Waldsmith, F. W. A. Vesper and others.

The Sherrard (Ill.) Power Company has been incorporated with a capital stock of $30,000 to supply electricity for lamps and motors in Sherrard. The incorporators are: D. W. Bowen, B. Bowen and Joseph Klucker.

The Allis-Chalmers Manufacturing Company will spend about $50,000 in enlarging its Bullock works, in Norwood, near Cincinnati. Five separate buildings will be constructed, giving some needed working space.

The Michigan Power & Paper Company of Toronto, Ont., Can., has been incorporated with a capital stock of $6,500,000 by William A. J. Case, 801 Dominion Bank Building, Toronto; James B. Taylor, William B. Smith and others.

The Electrical Supply Company of Joplin, Mo., has been chartered with a capital stock of $10,000 by C. H. Belden, E. M. Confer and Rex Chamberlain. The company proposes to deal in electrical supplies, equipment and appliances.

The Super Lighting Company of New York, N. Y., has been incorporated by A. M. Sullivan, F. E. Hebberd and S. S. Meyers, 318 West 100th Street New York, N. Y. The company proposes to manufacture optical system for headlights, signals, beacons, etc.

The American Sleeve Valve Motor Company of Wilmington, Del., has been incorporated, with a capital stock of $3,000,000, to carry on a general mechanical and electrical engineering business. The incorporators are: S. C. Seymour, F. R. Hansell and H. B. Martin.

The Amsden-Ferguson Company of Buffalo, N. Y., has been incorporated with a capital stock of $50,000 to manufacture and deal in lanterns, lamps, igniting devices, etc. The incorporators are: R. F. and H. F. Ferguson, T. G. Amsden, 238 DeWitt Street, Buffalo, N. Y.

The Fleischmann Illuminating Company of New York, N. Y., has been chartered with a capital stock of $20,000 by W. Rosenfeld, S. and N. Louden, 26 West 111th Street, New York City. The company proposes to deal in Fleischmann's light, heat, power and electric appliances.

Horace Keane, Inc., has filed articles of incorporation with a capital stock of $17,000 for the purpose of manufacturing and dealing in lighting appliances, effects, etc. The incorporators are: F. E. Hebberd, A. M. Sullivan and H. M. Keane, 165 Audubon Avenue, New York, N. Y.

The Lustrolite Electric Company of New York, N. Y., has been incorporated by J. Zwicki, A. McVicker and J. H. Conor, 222 West Forty-second Street, New York City. The company is capitalized at $25,000 and proposes to do a general contracting, electrical and mechanical engineering business.

The Lapp Insulator Company of Leroy, N. Y., has been incorporated by S. Levy, H. W. Rippey and J. B. Abbott of Geneseo, N. Y. The company is capitalized at $150,000 and proposes to manufacture and deal in electrical and mechanical apparatus, hardware, insulators, rubber, pottery, porcelain, etc.

The Central Utilities Company of Milwaukee, Wis., has filed articles of incorporation under the laws of the State of Delaware, with a capital stock of $200,000. The company proposes to take over small utility plants and operate them under one management. The directors are: W. N. Albertson, E. M. McVicker and others.

The Dyneto Electric Corporation of Albany, N. Y., has been incorporated to take over the business of the Dyneto Electric Company, which manufactures motors, dynamos, mechanical and electrical engineering supplies. The incorporators are: G. D. Mackay, H. Taffer and H. A. Rosenburg, 19 Cedar Street, New York, N. Y.

The International Electric Signal Company has filed articles of incorporation under the laws of the State of Delaware. The company is capitalized at $1,500,000 and proposes to install electric and pneumatic systems of signalling. The incorporators are: Samuel B. Howard, Joseph F. Curtin and Arthur Britton, all of New York, N. Y.

The Keystone Utilities Company has filed articles of incorporation under the laws of the State of Delaware. The company is capitalized at $5,000,000 and proposes to act as a holding corporation to a number of light and power properties located in Pennsylvania, which include the Hanover (Pa.) Light & Power Company, Hanover & McSherrystown Street Railway Company, Gettysburg (Pa.) Electric Company, Dubois (Pa.) Electric & Traction Company and the Susquehanna (Pa.) County Light & Power Company. Among the directors are: Frederick J. Platt, president of the Scranton (Pa.) Electric Construction Company; Everett J. Lynett, James A. Linen, Jr., all of Scranton, and others.

Trade Publications

Oil Engines.—The International Steam Pump Company, Buffalo, N. Y., has issued an illustrated and descriptive folder of its oil engines.

Arc Welding.—Electrical arc welding equipments, leaflet 3668-B, describing the equipment furnished for arc welding and explaining and illustrating the various places in which this form of weld may be successfully applied has been recently issued by the Westinghouse Electric & Manufacturing Company.

Industrial Equipment.—Bulletin No. 114, which is descriptive of a modern lumber mill, its electrical and mechanical equipment, has recently been prepared by the Wagner Electric Manufacturing Company of St. Louis. The bulletin is well prepared and shows many views of actual installation in mills.

Mine Substations.—Substations for mines are thoroughly described and illustrated in leaflet 3697 just issued by the Westinghouse Electric & Manufacturing Company in which a discussion is given of the use of motor generators and rotary converters for mining work. Installation views of mine substations are shown.

Textile Industry.—"The Silk-Throwing Industry in Northeastern Pennsylvania," by G. F. Smith and Elmer L. Kyle, a reprint of an article which appeared in the *Electric Journal*, September, 1915, has just been issued in pamphlet form by the Westinghouse Electric & Manufacturing Company. This paper describes the textile industry in northeastern Pennsylvania, and describes the operations performed by the machines used.

Motors, Generators and Regulators.—Among the publications recently issued by the Westinghouse Electric & Manufacturing Company are the following: Self-contained vertical shaft alternating-current generators, leaflet 3555-A, describing by means of diagrams and photographs the construction of this type of generator, particular attention being given to the Kingsbury thrust bearing used therein. Alternating-current motors for driving grinders, leaflet 3903. The particular features of the motor adapting it for this type of work are emphasized and illustrated. Leaflet 3927, on the automatic operation of induction feeder-voltage regulators. This is a comprehensive treatise on this subject, representing the latest developments in this type of apparatus, the demand for which has been very great during the past several months.

New England

ANTRIM, N. H.—The Public Service Commission has approved the sale of the electric properties owned by the Goodell Company of Antrim to the Antrim-Bennington Electric Light & Power Company, recently incorporated. The latter company has also been authorized to do business in the towns of Antrim, Bennington, Hancock and Greenfield.

BOSTON, MASS.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Jan. 16 for furnishing and installing exhaust steam system and furnishing ammeters, voltmeters annunciators, electrical supplies, etc., and turbo-generating sets at the navy yard, Boston Mass.

NORWOOD, MASS.—The general contract for addition to the municipal electric-light plant has been awarded to Walter Smith.

WORCESTER, MASS.—A contract has been awarded by the Wright Wire Company for the erection of a factory building, 64 ft. by 230 ft., at its local plant, to be equipped with a 2-ton electric traveling crane. The company will also build a boiler house at the plant.

BRIDGEPORT, CONN.—The City Council is considering extensions to the street-lighting system, including the installation of 69 ornamental units, 50 arc lamps and 60 tungsten lamps.

HARTFORD, CONN.—Further extensions are contemplated to the power plant of the Hartford Electric Light Company at Dutch Point, including the installation of a 10,000-kw turbo-generator and two boilers of the Bigelow-Hornsby type, for which orders have been placed. The company has filed a petition with the Secretary of State asking permission to extend its system to Manchester to supply electricity for commercial purposes. Samuel Ferguson is vice-president.

Middle Atlantic

ANTWERP, N. Y.—Plans are being considered by F. X. Beaumert & Company for the construction of a hydroelectric-light plant. Anderson & Jones of Carthage are architects.

ATTICA, N. Y.—At an election held recently the proposal to purchase the electric plant and water-works system of the Attica Water, Gas & Electric Company, to be owned and operated by the municipality, was carried.

BUFFALO, N. Y.—Drawings for the proposed substation of the New York Central Railroad Company at Bond and Clinton Streets as part of the $6,000,000 passenger and freight terminal development proposed south of Exchange and east of Washington Streets have been submitted to the Terminal Commission by the architects for the New York Central lines.

DUNKIRK, N. Y.—The Dunkirk Electric Manufacturing Company has notified its patrons that it will close down its electric plant the 15th of January.

HENDERSON, N. Y.—Application has been made to the Public Service Commission for approval of the transfer of the lighting system, owned by George N. Wilson to C. W. Valentine and M. B. Steele. The new owners contemplate the installation of a new lighting system in Henderson and Henderson Harbor and to establish a 24-hour service. Energy will be secured from the Northern New York Utilities Company, through the Adams power station. The company will be known as the Lake Shore Electric Company.

ITHACA, N. Y.—The Cayuga Power Company is contemplating extending its service to Dryden and also to Groton to supply energy to the Corona Typewriter Company. The company also contemplates erecting a transmission line from Ithaca to Groton via Freeville, with branch lines to villages in that vicinity.

NEW YORK, N. Y.—The By-Products Company, 10 Broadway, New York City, is contemplating the erection of addition to the boiler house at its plant on Shooter's Island, near Staten Island, to cost about $125,000. A new tankage plant will also be erected at a cost of about $150,000.

NEW YORK, N. Y.—Steps have been taken by the Public Service Commission looking to the installation in the near future of additional entrance and elevator facilities at the station of the first subway at Broadway and 168th Street. It is proposed to install shafts for four new elevators and to install two elevators at once and also to construct a mezzanine entrance and a new bridge across the tracks. The cost is estimated at $200,000.

ROCHESTER, N. Y.—Bids will be received by the State Hospital Commission, Capitol, Albany, until Jan. 30 for construction, heating and electric work of additions to Livingston Building (additional accommodation for disturbed patients), Rochester State Hospital, Rochester, Drawings and specifications may be consulted at the Rochester State Hospital; at the New York office of the Department of Architecture, 1224 Woolworth Building, and at the Department of Architecture, Capitol, Albany. Drawings and blank forms of proposal may be obtained at the Department of Architecture, Capitol, Albany. Lewis F. Pilcher is state architect.

SALAMANCA, N. Y.—Plans are being considered for extensions to the municipal electric-light and water plant, to cost from $12,000 to $15,000. H. E. Heller is superintendent.

SYRACUSE, N. Y.—The plans prepared by Henry C. Allen, city engineer, for the elimination of grade crossing on the New York Central, West Shore and Lackawanna Railroads, to cost about $8,000,000, including electric track installation, the cost to be divided between the city, state and railroads, it is reported, have been approved by Bion Arnold, engineer, of Chicago, Ill.

TROY, N. Y.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 31 for changes in plumbing, conduit and wiring and lighting fixtures in the United States post office, court house, etc., in Troy, N. Y. For details see proposal columns.

UNADILLA, N. Y.—The Standard Light, Heat & Power Company of Unadilla, which recently purchased and consolidated a number of electric plants in Delaware and Otsego Counties, has applied to the Public Service Commission for approval of the erection of transmission lines connecting the various isolated plants.

CHARLEROI, PA.—The Town Council has entered into a contract with the West Penn Power Lighting Company for street-lighting, under the terms of which the company is to install new street lamps, consisting of twelve 600-watt, six 400-watt, fifty-five 250-watt, thirty-five 100-watt, and sixty-three 80-watt lamps. The contract is for a period of ten years.

CHESTER, PA.—The Consumer's Ice Company is planning to double the capacity of its local ice manufacturing plant. The installation will include two water tube boilers, engine and a 75-ton ice machine. The cost of the work is estimated at $125,00.

DENVER, PA.—The Denver Street Railway Company, recently incorporated with a capital stock of $130,000, is planning to build an electric railway from Denver to Ephrata, a distance of 5 miles. H. S. Distler is president of the company.

HAZLETON, PA. — The Pond Creek Mines, it is reported, will be equipped for electrical operation. The Harwood Electric Company will supply energy to operate the mines.

LANSDOWNE, PA.—The Counties Gas & Electric Company, of Norristown, has been granted permission by the Public Service Commission to acquire the capital stock and control of the Lansdowne Construction Company, operating electric properties at Lansdowne and vicinity.

NEW CASTLE, PA.—The Council has awarded the contract for installation of an ornamental-lighting system. (three-lamp clusters) on Long Avenue and South Mill Street to the Price Electric Company, at $8,856.

NEW CASTLE, PA.—Charters for sixteen companies all of them affiliated with the Mahoning & Shenango Railway & Light Company of Youngstown, Ohio, to operate in Mercer, Lawrence and Butler Counties of Pennsylvania have been granted by Governor Brumbaugh as follows: Jackson Township of Butler; Big Beaver Township of Lawrence; Shenango Township of Lawrence; Wayne Township of Lawrence; Big Beaver Township of Lawrence; Big Beaver Township of Beaver; Franklin Township of Beaver; North Sewickley Township of Beaver; Borough of Farrell of Mercer; Borough of West Middlesex of Mercer; Borough of Wheatland of Mercer; Hickory Township of Mercer; Pymatuning Township of Mercer; Shenango Township. Mercer and Williamton township, Mercer Light & Power Companies. By the granting of these charters the plans of the Mahoning & Shenango Railway & Light Company are completed for the extension of transmission lines throughout the Sharon and New Castle industrial districts. Each company will be capitalized at $10,000 and will have offices in New Castle and are to operate in districts of the names taken and in counties names in the corporate title. The incorporators are: J. C. Chestnut, L. B. Round, H. N. Wood and M. Pendleton, all connected with the Mahoning and Shenango Company and C. H. Akens, attorney for the company at New Castle.

PHILADELPHIA, PA.—A new electric power plant will be built in connection with extensions at the hospital for the insane at Blockley. Contract for the structure has been awarded by the city.

PHILADELPHIA, PA.—Plans are being prepared by the General Scientific Equipment Company, 2719 West Lehigh Avenue, Philadelphia, for the erection of a factory, 110 ft. by 124 ft., three stories high, to provide adequate manufacturing facilities. The company proposes to manufacture scientific instruments, hydrometers, thermometers, etc., Maurice Kline is manager.

POTTSVILLE, PA.—The City Council will readvertise for bids for street-lighting. The Schuylkill Gas & Electric Company of Mahanoy City has submitted a proposition to supply the service at a lower rate than the Eastern Pennsylvania Light, Heat & Power Company, which now furnishes the service here.

WHITE HALL, PA.—The Lehigh Navigation Electric Company of Hauto is planning to erect new transmission lines in the township of White Hall, where it has been granted a franchise.

BURLINGTON, N. J.—Mayor E. E. Mount in his annual address to the City Council recommends the establishment of a municipal electric-light plant, with appointment of a committee to acquire the necessary data.

ELIZABETH, N. J.—In his annual message to the City Council Mayor Mravlag recommends the establishment of a municipal electric light plant in Elizabeth.

JERSEY CITY, N. J.—The Board of Freeholders is considering plans for increasing the output of the electric-light plant in Court House to furnish service for all county buildings and roads.

PERTH AMBOY, N. J.—The report of Thomas Grieve, superintendent of the water-works, submitted to the water commissioners, electrically operated pumping station and additional filtering basins. The cost of the improvements, exclusive of filtering basins, is estimated at $50,000.

SALEM, N. J.—The local plant of the Electric Company of New Jersey will be closed down soon, when energy for the system in Salem will be supplied from Bridgeton and Wilmington.

CUMBERLAND, MD.—Plans are being prepared for the erection of a manufacturing plant for the Kelly Springfield Tire Company in Cumberland, consisting of four or five factory buildings, storage building, emergency hospital, power plant, pump house and office building, to cost about $200,000. Edward Necarsulmer, 507 Fifth Avenue, New York, N. Y., is architect; S. Dieschler & Sons, Farmers Bank Building, Pittsburgh, Pa., are engineers. F. A. Seaman, Broadway & Fifty-seventh Street, New York, N. Y., is secretary.

ST. HELENA, MD.—Plans and specifications are being prepared by the Roland Park Company for an industrial city residential development for the employees of the Bethlehem Steel Corporation of Sparrows Point plants, involving an ultimate expenditure of from $4,500,000 to $5,000,000. The entire project will utilize about 700 acres; 300 acres will be used for the first unit; the improvements for this year will include the erection of several hundred houses (ultimately several thousand houses), roads, paved streets, water supply electric-lighting, sewers, playgrounds, athletic fields, etc. E. H. Bouton, 400 Roland Avenue, Roland Park, is president.

CHARLESTON, W. VA.—Bids will be received by the Board of Education, Charleston, W. Va., until Jan. 23 for construction of Junior High School, separate bids to be submitted on electrical work and plumbing. Revised plans and specifications are on file at the office of Frank L. Packard, architect, Columbus, Ohio, and at school building. W. O. Daum is secretary.

LOGAN, W. VA.—Preparations are being made by the Logan County Light & Power Company for the erection of an addition to power plant, to cost about $200,000. Bids, it is understood, will soon be asked. F. R. Weller, Hibbs Building, Washington, D. C., is engineer.

MORGANTOWN, W. VA.—Bids will be received by the State Board of Control, Charleston, W. Va., until Feb. 14 for furnishing material and construction of the

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

following buildings for the University of Virginia as follows: one agricultural building, 85 ft., 9 in. by 188 ft., three stories and basement, including heating, electrical work and plumbing; one girls' dormitory building 42 ft., 9 in. by 220 ft., 40 in., three stories and basement, including heating, electrical work and plumbing. Plans and specifications may be obtained at the office of the State Board of Control, Charleston, upon deposit of $10. Paul A. Davis, 3rd, 1713 Sansome Street, Philadelphia, Pa., is architect.

WINCHESTER, W. VA.—The Northern Virginia Power Company of Winchester, which for some months has been endeavoring to institute condemnation proceedings to acquire certain rights on the Shenandoah River near its plant, has won a decision before Judge Woods in the circuit court in Charleston, W. Va. The company proposes to make extensive improvements, raise the dam and increase the output of its plant.

NORFOLK, VA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Jan. 15 for furnishing two 300-kw. motor-generator sets and switchboard at the navy yard, Norfolk.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Brooklyn, N. Y., Schedule 611—25,000 ft. telephone cable; Schedule 610—miscellaneous copper tubing; Schedule 611—120,000 ft. twin conductor wire, 200 fire control telephones. Mare Island, Cal., Schedule 617—miscellaneous fittings, bushings and switches, 18 electric flatirons and 18 portable ventilating sets. Applications for proposal blanks should designate the schedule desired by number.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Boston, Mass., Schedule 591—2500 lb. copper bar. Newport, R. I., Schedule 602—250,000 lb. unannealed brass tubes, 25,000 lb. brass tubing; Schedule 604—25,000 ft. iridium platinum wire. Philadelphia, Pa., Schedule 593—one pile driver engine and boiler. Mare Island, Cal., Schedule 586—one 30-kw. generator. Applications for proposal blanks should designate the schedule desired by number.

North Central

DETROIT, MICH.—The contract for construction of an ice manufacturing factory and power plant, one and two story, 141 ft. by 128 ft. for Pittman & Dean, coal and ice dealers, 10 West Adams Avenue, has been awarded to Pine & Munnecke Company, 115 State Street.

LOWELL, MICH.—The municipal electric-light plant on Dec. 31 toppled over into the river and was practically destroyed. The accident is supposed to be due to quicksand upon which the concrete foundation is believed to have been built. The plant is valued at $60,000 and it is a question whether the generator and other equipment can be saved. Power will be furnished by the Edison company until the plant is rebuilt.

AKRON, OHIO.—The local power plant of the Northern Ohio Traction & Light Company was recently damaged by fire, causing a loss of about $12,000.

BLOOMVILLE, OHIO.—E. C. Snyder, receiver of the Bloomville Light & Heating Company, has petitioned the Seneca County Common Pleas Court to authorize the operation of the plant to be discontinued, which is now being operated at a loss. The Ohio Light & Power Company of Tiffin is erecting a transmission line from Tiffin to Bloomville.

CANTON, OHIO.—Extensive improvements and extensions are contemplated by the Central Union Telephone Company in Canton, involving an expenditure of about $150,000. The local system will be practically reconstructed. A new exchange building will be erected or a large addition will be made to the present structure.

CLEVELAND, OHIO.—The National Acme Company, 212 East 131st Street, Cleveland, contemplates the construction of a power plant, to cost about $16,000.

CLEVELAND, OHIO—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until Jan. 17 for a gas engine-driven generating unit for the division of the city farm at Warrensville, Department of Public Welfare. Specifications may be obtained upon application to the secretary to the director of public welfare, Room 327, City Hall.

CLEVELAND, OHIO.—The general contract for the construction of five mercantile buildings, consisting of an ice rink, two stories, 154 ft. by 261 ft.; store and hotel, four stories, 74 ft. by 51 ft.; store and hotel, five stories, 101 ft. by 120 ft.; market house, one story, 150 ft. by 150 ft., and power and refrigerating plant for the Euclid Loan Company, is reported to have been awarded to the Crowell, Lundoff, Little Company, 1951 East Fifty-seventh Street. The total cost of the work is estimated at $600,000. The Allen, Osborne Company, Rose Building, has charge of the engineering work. A. J. Harvey, the Arcade, is president of the Euclid Loan Company.

LEIPSIC, OHIO.—The local plant of the Northwestern Ohio Light Company was badly damaged by fire recently.

LORAIN, OHIO.—The Public Utilities Commission has granted the Lorain County Electric Company permission to close a lease for the property of the Citizens Gas & Electric Company for a period of 25 years, at a total consideration of $250,000. Extensive improvements and extensions are contemplated.

MARIETTA, OHIO.—Plans are being considered by E. B. Young, president of the Hocking & Sunday Creek Traction Company for equipping the M. C. & C. railroad property for electrical operation. Energy will be supplied by the Hocking Power Company's electric power plant. The Hocking Power Company proposes to supply electricity for lamps and motors to towns along the railroad.

MANCHESTER, KY.—The installation of an electric-light plant in Manchester is under consideration. It is reported that $25,000 has been subscribed toward the project. A small bond issue will also be voted.

MURRAY, KY.—Contract for the construction of a municipal electric plant, it is reported, will be awarded Feb 1. Bonds to the amount of $20,000 have been voted for the system.

NEWPORT, KY.—Plans are being considered by the City Commissioners to require all the public service companies to place their electric wires underground in the business section of the city.

STAMPING GROUND, KY.—Steps have been taken toward establishing an electric-light and power plant in Stamping Ground. W. W. Caficy is interested.

CONNERSVILLE, IND.—The Public Service Commission has granted the Connersville Hydro-Electric Light & Power Company, recently incorporated, permission to consolidate the Connersville Light & Power Company and the Hydro-Electric Light & Power Company with the new company. Authority to issue $240,000 in capital stock was also asked by the company.

DELPHI, IND.—The Council of Carroll County is considering the installation of a power plant in the new court house in Delphi to supply electricity for lighting and operating electric elevator in the new building. E. E. Dunlap of Indianapolis is architect.

FORT WAYNE, IND.—The Fort Wayne & Northern Indiana Traction Company is contemplating altering its boiler room, either by the addition of a 1000-hp. unit, equipped with underfeed stokers and erection of new smokestack, or by re-equiping the present boilers with underfeed stokers. The company will furnish energy to the new factories of the General Electric Company, which will require from 2000 to 3000 kw., which will be connected up about March 1. Two new 4-wire circuits (copper wire, 4000 volts), eadh 1½ miles long, will be erected to supply the service.

KOKOMO, IND.—The Indiana Railways & Light Company contemplates extensive improvements to its power plant in Kokomo, including the installation of four new boilers of 500 hp., to cost approximately $48,000; a 5000-kw. turbine with necessary auxiliaries, to cost about $90,000, and additional pumps, heaters and other devices, at a cost of $10,000. The installation of 250 new street lamps, to cost from $10,000 to $12,000, is also under construction.

MONGO, IND.—The Farmers & Merchants Light & Power Company, recently incorporated with a capital stock of $500,000, proposes to supply electricity for lamps and motors in this section. Hiram Himebaugh is interested in the company.

ROCHESTER, IND.—Beginning with January 1, 1917, the business of the Rochester Electric Light, Heat & Power Company will be operated under the name of the United Public Service Company, which has operated some of the Rochester company's extensions for about two years. No change has been made in the officers and management. Charles A. Davis is treasurer.

SALEM, IND.—Options, it is reported, have been taken by the Inter-State Service Company of Indiana for the construction of a new plant in Salem. Temporary repairs have been made to the local plant following the recent fire.

SULLIVAN, IND.—The Vandalia Coal Company, which is now sinking two large mines east of this city, it is reported, will erect a large power plant to supply electricity to its mines in this district and to the proposed new traction line, which it is stated, will be built next summer from Sullivan to Linton, through Dugger, thence through Bruceville and Bicknell to Vincennes.

CHICAGO, ILL.—The general contract for construction of boiler house addition to central power station of Swift & Company, Chicago, has been awarded to the C. A. Moses Construction Company, 133 Washington Street. The cost is estimated at $50,000. Oscar Shanks is engineer.

JACKSONVILLE, ILL.—Bids will be received by the Board of Commissioners of the Valley Drainage & Levee District, at the office of the Jacksonville Engineering Company, City Hall Building, Jacksonville, until Jan. 22 for furnishing and directing a 125-hp. oil engine, additional building, etc.

TAYLOR SPRINGS, ILL.—The City Council has granted the Southern Illinois Light & Power Company of Hillsboro a franchise to construct a line to the smelter of the American Zinc Company.

AMERY, WIS.—Plans have been completed, it is reported, by the Apple River Milling Company of Amery for the construction of a power plant. J. C. Jacobson, Security Building, Minneapolis, Minn., is architect.

GREEN BAY, WIS.—The Wisconsin Public Service Company contemplates the construction of a 500-kw. auxiliary steam station in Manitowoc; also the reconstruction of the 7-mile transmission line of the Manitowoc & Northern Traction Company between Manitowoc and Two Rivers to supply energy for lamps in Two Rivers and for operating the railway.

IRON RIVER, WIS.—A company is being organized by T. N. Okerstrom of Port Wing, backed by Minneapolis men, to construct a power plant on the Iron River at the falls at a point 2 miles from the mouth of the river.

NEWBURG, WIS.—Plans are being considered by Dr. H. F. Weber of Newburg for the construction of an electric-light plant to supply electrical service in the villages of Newburg, Boltonville, Saukville and other smaller villages.

RACINE, WIS.—Plans are being prepared for the erection of an addition to the power plant of the Milwaukee Electric Railway & Light Company in Racine, to cost about $18,000.

HIBBING, MINN.—The village of Hibbing, it is reported, has postponed indefinitely the construction of the proposed new municipal electric-light plant. C. L. Pillsbury, Metropolitan Life Building, Minneapolis, is consulting engineer.

ST. PAUL, MINN.—The installation of an ornamental lighting system on Robert Street, between Eighth Street and Central Avenue, to cost about $8,357, has been approved by the Council. Plans are also being considered for the installation of ornamental lamps on Rice Street, between University Avenue and Maryland Street, on Cedar Street from Third Street to Central Avenue, and on Third Street, from Jackson to Robert Street.

VICTORIA, MINN. — The Waconia (Minn.) Light & Power Company has been granted a franchise to erect a transmission line into the village of Victoria.

IOWA CITY, IOWA.—The Capitol City Electric Company of Des Moines submitted the lowest bid ($11,781) for electric wiring for three school buildings in the First Ward.

LANESBORO, IOWA.—The local electric-light plant, owned by J. R. Davis, was recently destroyed by fire.

SPENCER, IOWA.—Contract for equipment for the municipal electric-light, consisting of two 300-hp. water tube boilers, with type "E" stokers; one 375-kva. direct connected unit, tandem compound Corliss engine, and one switchboard complete, at a total of $38,705, has been awarded to the Northwestern Electric Equipment Company of St. Paul, Minn. W. E. Skinner, 715 Plymouth Building, Minneapolis, Minn., is consulting engineer.

KANSAS CITY, MO.—Plans have been prepared by Wight & Wight, Kansas City, for the construction of an interurban terminal station in this city for the Kansas City Interurban Terminal Company, to cost about $1 400.000. Franchise is now pending in the City Council.

COURTNEY, N. D.—An election will

soon be held to submit the proposal to issue bonds for the installation of a municipal electric-light plant to the voters.

KENSAL, N. D.—Plans are being considered for the installation of an electric-light plant in Kensal. Anton Feckler is reported interested.

GARRETSON, S. D.—Bonds to the amount of $18,000 have been voted for additional equipment for the municipal electric-light plant.

MALMO, NEB.—At a special election to be held Jan. 16 the proposal to issue $3,500 in bonds for the installation of an electric-lighting system will be submitted to the voters.

OMAHA, NEB.—Plans are nearly completed for the construction of a steam and electric bakery, to cost about $100,000, in Omaha, for the Union Pacific Baking Company. The C. D. Cooley Company of Pittsburgh, Pa., and Kansas City, Mo., are architects.

ANTHONY, KAN.—Bids will be received by W. R. Canaan, city clerk, until Jan. 24, for furnishing and erecting one steam engine and generator, directly connected, at the municipal electric plant. Bids are requested on two units as follows: one 150-kw. direct-connected unit, consisting of one 150-kw. generator and steam engine, and switchboard, and on one 75-kw. generator and steam engine, directly connected, and switchboard. Only one of the above units will be purchased. Specifications are on file at the office of the city clerk, Anthony, and at the office of Black & Veatch, Inter-State Building, Kansas City, Mo.

LA CROSSE, KAN.—At an election held recently the proposal to issue $12,500 in bonds for the installation of a municipal electric-light plant and $40,000 for water-works system was carried. Stevens & Stiles, 221 Commerce Building, Kansas City, Mo., are engineers.

LENORA, KAN.—Bids will be received at the office of C. W. Thuma, city clerk, Lenora, until Jan 30 for construction of a municipal electric-light plant as follows: (1) For internal combustion engines installed complete on foundations built under separate contract. Bids to be submitted on the following combinations: two 25-hp., one 25-hp., one 35-hp., and two 35-hp. (2) Two 20-kw. alternators, two 25-kw. alternators, one 20-kw. and one 25-kw. alternator; one constant-current transformer, switchboard and all station equipment. (3) Furnishing all material for transmission lines. (4) Furnishing material not named in "List of Materials" and labor for erecting station and all station equipment. Plans and specifications are on file in the office of the city clerk and at the office of George P. Taylor, engineer, Stockton, Kan.

MUNDEN, KAN.—At an election held recently the proposal to issue $20,000 in bonds for the installation of an electric-light plant and water-works system was carried. Stevens & Stiles, Commerce Building, Kansas City, Mo., are engineers.

WICHITA, KAN.—The Arkansas Valley Interurban Railway Company, it is reported, contemplates the construction of three extensions, work to begin next spring; from Hutchinson to Kinsley and Great Bend, and from Newton to Salina.

Southern States

ATLANTA, GA.—The Georgia Railway & Light Company has decided to replace the 313 flaming arc lamps now in use throughout the city with nitrogen-filled lamps.

PENSACOLA, FLA.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Jan. 16 for furnishing transformers at the navy aeronautic station at Pensacola. Further information may be obtained at the above bureau or to the supply officer at Pensacola.

BEARDON, TENN.—Bids will be received by the Colonial Lumber Company, Beardon, until Jan. 31 for furnishing and erecting about 3 miles of wiring and from 300 to 500 lamps; poles and electricity to be supplied by the company, who will also consider the purchase of complete equipment for a 50-hp. plant for sawmill and electric lighting; gas engine to be used. J. D. Wyrick is manager of the company.

MONTGOMERY, ALA.—The Montgomery Light & Traction Company contemplates extending its street railway from Pickett Springs to Wetumpka, a distance of 9 miles, during 1917.

WOODVILLE, MISS.—Preparations are being made by the city of Woodville to install additional machinery in the municipal electric-light and water plant, including one 75-hp. fuel oil engine, semi-Diesel type; belt-driven air compressor and one two-stage centrifugal pump having a capacity of 250 gal. per minute. Bids have been received for the above equipment.

CHARLESTON, ARK.—The City Council has granted the People's Service Company, which has purchased the electric plant at Paris, a 25-year franchise to supply electricity in Charleston.

MINERAL SPRINGS, ARK.—The Nashville Ice, Coal & Light Company of Nashville is contemplating extending its electric transmission lines to Mineral Springs. The lighting service is already within a few miles of this place.

SPRINGDALE, ARK.—The Springdale Light & Power Company contemplates rebuilding its system, including construction of new power house and lines. M. C. and C. C. Martin have recently taken over the property.

NEW ORLEANS, LA.—Plans are being considered for extensive improvement to the street-lighting system, provision for which has been made in the new contract with the New Orleans Railway & Light Company. Preliminary plans provide for the installation of about 1800 standards, which will be mounted with 250-cp. units.

VIDALIA, LA.—Plans are being considered for the installation of an oil engine in the municipal electric-light plant, which is now operated by steam power. The Council is also considering a proposal submitted by the Southern Railway & Light Company of Natchez, Miss., which provides for laying a cable by the company across the Mississippi River and supplying energy to the Vidalia switchboard.

COWETA, OKLA.—The town of Coweta is in the market for the purchase of one 100-hp. gas engine and one 75-kw. three-phase, 60-cycle, 2300-volt generator, directly connected. No belt-driven units will be considered. G. W. Obenchain is superintendent of the water and light department.

KAW CITY, OKLA.—At a recent election bonds to the amount of $25,000 were voted for the installation of an electric-lighting plant and water works system in Kaw City.

STROUD, OKLA.—Contract for improvements to the municipal electric-light plant and water-works system has been awarded to the Chicago, (Ill.) & Iron Company, at $30,000.

EL PASO, TEX.—Extensions and improvements to its power plant and system is under consideration by the El Paso Electric Railway Company.

LUBBOCK, TEX.—Estimates have been received by the City Council of the cost of the installation of a municipal electric-light plant. The cost is estimated at about $40,000.

WILLS POINT, TEX.—The capital stock of the Wills Point Electric Light Company has been increased from $10,000 to $20,000. The company contemplates improvements to its plants.

Pacific States

INDEX, WASH.—The Town Council has engaged G. N. Miller of Seattle to take charge of the engineering work in connection with the construction of a municipal electric-light plant. Notice of appropriation of water on Deer Creek to furnish power to operate the proposed plant has been filed with the county auditor. The Council is also considering plans to establish a municipal water-works system to be operated in conjunction with the electric plant.

KENNEWICK, WASH.—The City Council is considering a proposal submitted by the Pacific Light & Power Company for installing a new street-lighting system in the business section. The plans provide for replacing the carbon lamps now in use with nitrogen-filled lamps, and to substitute the prismatic Holophane shades for the metal shades now in use. The Council is considering entering into a 10-year contract for street-lighting with the company.

LYNDEN, WASH.—The City Council is considering the proposal of the Puget Sound Traction, Light & Power Company to extend the street-lighting system in Lynden.

PALOUSE, WASH.—The City Council has appointed a committee to investigate the proposition of granting a franchise to the Washington Water Power Company of Spokane to erect transmission lines and a distributing system in Palouse. The Council has also decided to ask the Washington-Idaho Light & Power Company of Lewiston, Idaho, to submit a proposal for lighting the streets and residences of the city.

SEATTLE, WASH.—Bids will be received by the Board of Public Works, Seattle, until Feb. 16 for construction and equipment of an addition to the Lake Union municipal steam auxiliary plant, for which $390,000 in bonds have been authorized by the City Council. The new addition will increase the output of the plant from 7500 to 15,000 kw. J. D. Ross is superintendent of lighting.

ASTORIA, ORE.—A. G. Spexarth of Astoria is planning the installation of an electric-light plant in the Spexarth Building in this city.

HALSEY, ORE.—The City Council has passed an ordinance providing for the installation of street lamps. A contract has been signed for street lighting for a period of five years with the Oregon Power Company of Eugene.

ARBUCKLE, CAL.—The Northern California Power Company of San Francisco contemplates building a substation in Arbuckle.

LOS ANGELES, CAL.—The Board of Works has contracted with the Southern California Edison Company of Los Angeles for the erection of a temporary electric transmission line for use in connection with the contruction of the Bellevue Avenue outfall sewer at Hyperion and for the maintenance of 37 lamp posts on Sixth Street.

PACOIMA, CAL.—Application has been made to the State Railroad Commission by the Tejunga Water & Power Company, Wright & Callender Building, Los Angeles, for permission to issue $150,000 in bonds for improvements in Big Tejunga Canyon, including additional pipe lines.

SACRAMENTO, CAL.—In the biennial report of George Radcliff, state superintendent of Capitol buildings and grounds, submitted to Governor Hiram W. Johnson, recommends that in drawings plans for the two new buildings of the Capitol extension, to cost about $3,000,000, that the architects be requested to prepare the basement plan of the new office building to provide space for an electric generating plant, making it possible for the state to supply electricity for all the departments.

SAN FRANCISCO, CAL.—City Engineer O'Shaughnessy has recommended to the Supervisors the award of the contract for installing the electric cables and lighting fixtures in the Twin Peaks tunnel to R. C. Storrie & Company, at $11,650.

SAN FRANCISCO, CAL.—Preliminary plans have been prepared by James J. Walsh of San Francisco, at the request of the local steamship operators, for an elevated electric railway along the water front from the channel to Fort Mason, about 2.8 miles, to cost approximately $1,120,000.

SANTA ROSA, CAL.—Application has been filed with the State Railroad Commission by the California Telephone & Light Company for permission to purchase the water systems of the Calistoga (Cal.) Electric Company and the Calistoga (Cal.) Water Company.

SOUTH PASADENA, CAL.—The Pacific Light & Power Company is contemplating removing its substation in the city to a new location just outside the city limits.

TORRANCE, CAL.—Work has begun on the construction of the new car shops for the Pacific Electric Company of Los Angeles at Torrance. Fourteen buildings will be erected at this time, these forming the first and principal unit of a group that will ultimately include thirty or more structures. The new buildings, including equipment, will cost about $500,000.

EDEN, IDAHO.—The Idaho Power & Light Company of Boise has been granted a franchise to erect a power plant in Eden.

PRESCOTT, ARIZ.—Contract has been awarded by the Arizona Power Company of Prescott for the construction of an electric power plant on the Verde River, 3 miles north of Clarkesdale, to cost about $1,000,000, to Charles C. Moore & Company of San Francisco, Cal. The plans provide for a development of from 15,000 to 20,000 hp.

Canada

CHATHAM, ONT.—The City Council has adopted a resolution requesting the Ontario Hydro-Electric Power Commission to consider taking over the electrical department of the Chatham Gas Company, to be operated in conjunction with the Chatham hydroelectric system.

SUDBURY, ONT.—The Town Council is considering securing power from French River through the hydro organization for Sudbury in order to supply electricity to the British-American Company, which operate the Murray Mine. The cost of the proposed development is estimated at $2,000,000.

TORONTO, ONT.—The Chippewa hydro-electric power development project of the Ontario-Hydro Electric Power Commission has been approved by all the municipalities interested, with the exception of Goderich.

14,239. CARTRIDGE FUSE; Albert F. Daum, Pittsburgh, Pa. App. filed Oct. 30, 1915. In which the fuse wire, strip or ribbon may be positively and reliably clamped to the terminal caps.

1,210,389. MANUAL AND SEMI-AUTOMATIC TELEPHONE SYSTEM; William Aitken, London, England. App. filed Aug. 24, 1915. Operations are wholly or partly manual.

1,210,398. SUCCESSIVE NON-INTERFERENCE SIGNAL-BOX; Clarence E. Beach, Binghamton, N. Y. App. filed Aug. 11, 1913. Improvement.

1,210,424. TELEPHONE DESK SET; Edward B. Craft, Hackensack, N. J. App. filed March 2, 1915. Condenser and induction coil are mounted within the standard.

1,210,444. BRAKE SYSTEM; Nathan Fallek, Denver, Col. App. filed May 11, 1914. Improvements.

1,210,445. MINING-MACHINE CABLE-CONNECTOR; Thomas G. Fear, Bayview, Ala. App. filed Nov. 3, 1915. Mining machine may be connected to the trolley wire.

1,210,463. TELEPHONE-RECORDER; Rupert H. Greenlaw, Lawrence, Mass. App. filed April 5, 1915. Number of calls sent and received.

1,210,470. INSULATOR-CLAMP; Edwin G. Hatch, Hoboken, N. J. App. filed Jan. 19, 1915. Conductor is supported on top of the insulator.

1,210,481. MONITOR SYSTEM FOR CARRIER-DESPATCH APPARATUS; Chester S. Jennings, Boston, Mass. App. filed April 8, 1914. Pneumatic tube apparatus.

1,210,492. OUTLET-BOX; Julian Gordon Knight, New York, N. Y. App. filed Aug. 24, 1912. Interior is accessible from the top or upper side after the box has been placed.

1,210,499. TELEPHONE SYSTEM; John H. Levis, Jr., Rochester, N. Y. App. filed Feb. 7, 1916. Provide an intercommunicating telephone system with improved means for obtaining a central-exchange connection.

1,210,503. RAILWAY-SIGNAL; Daniel G. Lyzen, Grand Rapids, Mich. App. filed Nov. 2, 1914. Motormen on one car may be apprised of the approach of a car on an intersecting or cross-line of track.

1,210,505. POINT-FINDER SYSTEM; Alben E. Lundell, New York, N. Y. App. filed Nov. 28, 1914. Keyboard controllers.

1,210,528. CONNECTOR FOR REACTANCE-COILS; John F. Peters, Edgewood Park, Pa. App. filed Oct. 3, 1914. Current-limiting reactance coils.

1,210,540. CATHODE-RAY TUBE; Hans Ewald Reinhold Rukop and Wilhelm Kuno Max Schloemilch, Berlin, Germany. App. filed Oct. 28, 1915. Pure electron tubes under a high vacuum.

1,210,554. STREET-INDICATING MECHANISM; Thomas W. Small, Cleveland, Ohio. App. filed Nov. 24, 1909. Improvement.

1,210,566. METHOD OF AND APPARATUS FOR TESTING CONDUCTORS FOR FAULTS; James A. Vahey, Boston, Mass. App. filed April 28, 1915. Alternating voltage which will result in a current flow whether the conductor be a faulty or a healthy conductor.

1,210,568. PROTECTIVE APPARATUS FOR ELECTRIC CIRCUITS; Eugene M. Vogel, Oak Park, Ill. App. filed May 1, 1914. Conveniently employed in a signal box or in similar situations.

1,210,581. CIRCUIT-CONTROLLER; Johan M. Andersen, Boston, Mass. App. filed June 18, 1913 Distant controlled switch or circuit breaker.

1,210,586. BOILER; Harvey W. Bell, Pittsburgh, Pa. App. filed June 26, 1915. Adapted to be heated by flame from a gas or oil burner.

1,210,591. ELECTRIC HEATING APPARATUS; Albert R. Braden, Beverley, Mass. App. filed July 16, 1915. Heating metal strips.

1,210,602. TELEPHONE-EXCHANGE SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed Sept. 8, 1915. Central Energy type.

1,210,603. CALLING DEVICE; Henry P. Clausen, Mount Vernon, N. Y. App. filed Aug. 30, 1916. Automatic and semi-automatic telephone systems.

1,210,604. TELEPHONE-EXCHANGE SYSTEM; Edward E. Clement, Washington, D. C. App. filed July 12, 1912. Applicable to automatic and semi-automatic connective systems therefor.

1,210,609. WATTMETER; Charles W. Davis, Edgeworth, Pa. App. filed Oct. 19, 1914. Arrangement of the connections.

1,210,616. MACHINE-SWITCHING TELEPHONE-EXCHANGE SYSTEM; Bert G. Dunham, Hawthorne, N. J. App. filed Sept. 14, 1915. Provides an improved connector circuit.

Record of Electrical Patents

Notes on United States Patents issued on Jan. 2, 1916.

1,210,617. RELAY; Bert G. Dunham, Hawthorne, N. J. App. filed Oct. 12, 1915. Slow-acting relays.

1,210,620. EXHAUSTING-MACHINE; John T. Fagan and Cleveland H. Quackenbush, Cleveland, Ohio. App. filed Dec. 2, 1914. Incandescent lamp bulbs and other articles in which a vacuum is required.

1,210,628. LOADING-COIL; William Fondiller, New York, N. Y. App. filed June 21, 1916. For loading phantom telephone lines.

1,210,638. DYNAMO-ELECTRIC MACHINE; Johann Geisslinger, Geneva, Switzerland. App. filed May 23, 1912. Improvements.

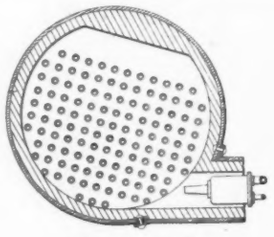
1,210,639. DYNAMO-ELECTRIC MACHINE; Johann Geisslinger, Geneva, Switzerland. App. filed June 17, 1913. Magneto electric generator well adapted for lighting electric lamps

1,210,640. BRAKE-LOCK FOR AUTOMOBILES; Leon Goldmerstein, New York, N. Y. App. filed March 25, 1916. Improvements.

1,210,642. SELECTIVE SIGNALLING SYSTEM; John Brayton Harlow, New York, N. Y. App. filed May 6, 1915. Single track railway system.

1,210,652. TELEPHONE-EXCHANGE SYSTEM; Lewis H. Johnson, Bloomfield, N. Y. App. filed March 10, 1915. Systems of the divided multiple type.

1,210,653. TELEPHONE-EXCHANGE SYSTEM; Lewis H. Johnson, Bloomfield, N. J. App. filed May 26, 1916. Central energy type.



1,210,586 Boiler

1,210,658 ELECTRIC SWITCH; Charles J. Klein, Milwaukee, Wis. App. filed Aug. 26, 1912. To control a plurality of circuits or branches of a single circuit.

1,210,659. ELECTRIC SWITCH; Charles J. Klein, Milwaukee, Wis. App. filed Jan. 13, 1913. Double pole panel-board switch.

1,210,663. ELECTROPLATING AND LACQUERING APPARATUS; John J. Mace and John Roy Murr, York, Pa. App. filed Oct. 9, 1915. For electro-plating or galvanizing wire cloth and lacquering the same.

1,210,678. THERMIONIC AMPLIFIER; Alexander McLean Nicolson, N. Y. App. filed May 19, 1915. Improved organization of electrodes.

1,210,685. INSULATOR-SUPPORT; Charles L. Peirce, Jr., Pittsburgh, Pa. App. filed Feb. 5, 1916. Comprising a bracket part of sheet metal to give supporting strength, and a wooden thimble for providing a resilient seat for insulators.

1,210,686. INSULATOR-SUPPORT; Charles L. Peirce, Jr., Pitstburgh, Pa. App. filed April 6, 1916. New and useful improvements.

1,210,687. INSULATOR-SUSPENSION BRACKET; Charles L. Peirce, Jr., Pittsburgh, Pa. App. filed May 17, 1916. To be suspended from a messenger cable

1,210,691. LIQUID-HEATER; Fred Poole, Jewell City, Kan. App. filed Feb. 9, 1915. Instantaneous.

1,210,703. COMMUTATOR; Charles F. Schneider, Springfield, Ohio. App. filed July 21, 1914. Simplify the construction of the armature of electric machines.

1,210,705. APPARATUS FOR POWER DISTRIBUTION; Rudolph F. Schuchardt, Chicago, Ill. App. filed Jan. 12, 1912. Protect the apparatus and circuits of an electrical system against faults which may occur in a part only of the system.

1,210,709. SPEED-CONTROLLED ELECTRIC SWITCH; Thomas W. Scott, Baltimore, Md. App. filed April 17, 1914. To control an electric circuit in a speed-control mechanism for railway vehicles.

1,210,710. CONTINUOUS CONTROLLING MECHANISM FOR VEHICLES; Thomas W. Scott, Baltimore, Md. App. filed March 23, 1915. Provide for the continuous control of a train or vehicle throughout its travel along the trackway.

1,210,738. INDICATOR FOR FAUCETS; Joseph E. Ward, Hanover, N. J. App. filed June 15. 1914. Indicator is operated in unison with the faucet.

1,210,750. DYNAMO-ELECTRIC MACHINE; Thomas S. Allen, Milwaukee, Wis. App. filed July 14, 1909. Rotating members.

1,210,764. BINDING-POST; Frederick W. Cole, Newton Highlands, Mass. App. filed Nov. 24, 1915. Terminal portion of the wire may be arranged on a seat coextensive with the diameter of the post, and impinged by the binding-screw for a considerable length.

1,210,765. SIGNAL-BOX; Frederick W. Cole, Newton Highlands, Mass. App. filed Nov. 24, 1915. Switch-element is made as a unit.

1,210,786. SECONDARY OR STORAGE BATTERY; Bruce Ford, Philadelphia, Pa. App. filed April 22, 1915. Means for preventing or opposing the entry of sea water through the vent of storage battery jars.

1,210,787. SECONDARY OR STORAGE BATTERY; Bruce Ford, Philadelphia, Pa. App. filed April 22, 1915. Proper ventilation.

1,210,794. FURNACE-DRAFT OPERATOR; Walter Hann, Hasbrouck Heights, N. J. App. filed April 18, 1916. Device for electrically operating a draft opening mechanism.

1,210,816. RAILWAY SIGNALING SYSTEM; Reed M. Lewis, Aliquippa, Pa. App. filed Nov. 4, 1914. Forming blocks or sections.

1,210,821. BATTERY-LAMP; Henry Ed. McClure, Marion, Ind. App. filed Feb. 5, 1915. Lamp attachment adapted to be connected to the terminals of one or more cells.

1,210,851. ELECTRICAL CONNECTOR; Otto Schaefer, New York, N. Y. App. filed Nov. 20, 1914. For portable electrical apparatus.

1,210,872. PROCESS OF MAKING ELECTROTYPE-PLATES OR METALLIC SHELLS; Frank T. Thompson, Chicago, Ill. App. filed Aug. 4, 1916. Improved process.

1,210,884. PHANTOM-CIRCUIT LOADING; John Franklin Baldwin, Jr., East Orange, N. J. App. filed June 27, 1916. For simultaneously loading two physical circuits and their derived or phantom circuit.

1,210,889. REGULATING APPARATUS; Joseph Bijur, New York, N. Y. App. filed Nov. 18, 1911. New and useful improvements.

1,210,912. SELECTING MECHANISM AND SYSTEM; Amos F. Dixon, Newark, N. J. App. filed March 27, 1915. Electromechanical type.

1,210,917. CALLING DEVICE; Alfred H. Dyson, Chicago, Ill. App. filed Feb. 14, 1912. Setting member is actuated to adjust impulse mechanism.

1,210,966. SIGNAL APPARATUS FOR MOTOR-VEHICLES; Max A. Miller, Maywood, Ill. App. filed March 31, 1916. Rear signal.

1,211,000. APPARATUS FOR RENDERING A PROTECTIVE DEVICE RESPONSIVE TO PHASE RELATIONS; Severn D. Sprong and Walter E. McCoy, New York, N. Y. App. filed March 2, 1916. Consists in establishing phase relations substantially 180 deg. apart.

1,211,006. ELECTRIC-CURRENT COLLECTOR; Alfred G. Taylor, Greenville, S. C. App. filed May 24, 1916. Frame is pivotally secured to a trolley pole.

1,211,010. CONDUCTOR-SUPPORT; John T. Tighe, Scranton, Pa. App. filed July 8, 1914. For overhead trolley wires.

1,211,016. ARC-LAMP; John Vintila, Cleveland, Ohio. App. filed Jan. 19, 1916. Used in motion picture work.

1,211,017. MEANS FOR THE REGULATION OR CONTROL OF RAILWAY AND LIKE TRAFFIC; Hans Von Kramer, Edgbaston, Birmingham, England. App. filed June 1, 1916. Improvement.

1,211,031. TELEPHONE SYSTEM AND APPARATUS; Allison Akin, East Orange, N. J. App. filed June 21, 1915. Combined electromagnetic signal controlling relay and impedance coil for a bridged impedance type of link circuit.

1,211,044. SIGNALING SYSTEM; Henry M. Bascom, Brooklyn, N. Y. App. filed Sept. 7, 1915. Telephone.